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Volume XX ★ Number 4 ★ Dec. 1957

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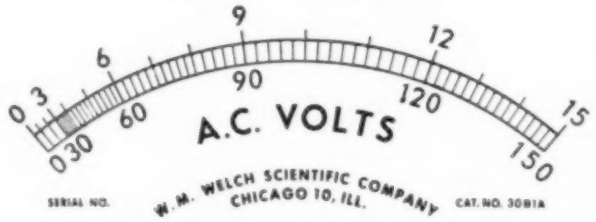

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By Kathryn E. Boydston, Fernwood, Niles, Michigan.

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We are planning a series of articles on elementary science education. This series is being prepared in answer to a large number of requests from teachers. We welcome your suggestions concerning the type of articles you desire to see in our pages.

The Plentiful Rare Earths

• By **Howard E. Kremers, Ph.D.,** *(University of Illinois)*
LINDSAY CHEMICAL COMPANY, WEST CHICAGO, ILLINOIS

Although the rare earth elements have been used for many years in a number of important applications, they are usually ignored or only casually mentioned in most elementary science courses.

The availability of rare earths in large quantities has stimulated interest in them, and in the last two decades has led to many interesting applications of this unusual group of fifteen elements.

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In the early 1900's, incandescent gas lamps were lighting the homes, industries, and the streets of America. The heart of these glowing lamps was the gas mantle. The basic material required for the manufacture of gas mantles is thorium nitrate, and it is obtained from monazite ore, the only commercial ore of thorium.

Monazite contains from 5 to 20 times as much of the rare earths as it does thorium; however, most of the rare earths were discarded during the early years of this century since they had no significant value.

The decline in the use of incandescent gas mantles through the years resulted in an intensive effort by the producers of thorium nitrate to find markets for the by-product rare earth materials which they had been discarding. Some of the common uses today for rare earth materials were developed during and shortly after the period of World War I.

The rare earths are the fifteen elements in the periodic table having atomic numbers from 57 to 71 (see Table 1.) Fourteen of these fifteen elements occur in nature, element number 61, promethium, being produced as a fission product in atomic reactors. Although they are not rare earths, the elements yttrium, atomic number 39, and thorium, atomic number 90, are always found with the rare earth in their ores and minerals. In fact, the properties of yttrium are so much like those of the rare earths that it is difficult to separate yttrium from a rare earth mixture.

To avoid the implication that the elements are rare, the names "lanthanides," or "lanthanons" are sometimes used to describe these materials.

The rare earths are transition elements wherein the inner 4*f* electron shell is progressively filled going from lanthanum to lutetium without changing the outer electronic shells. For this reason, the chemical properties and many of the physical properties of the rare earths are quite similar. Separation of a rare earth mixture therefore is often a very difficult procedure.

In most of their compounds, the rare earths are trivalent. Compounds of cerium, praseodymium, and terbium are sometimes quadravalent, and samarium, europium and ytterbium can form some divalent compounds. The compounds of quadravalent cerium resemble very closely the corresponding compounds of thorium.

Common water soluble rare earth compounds are the acetates, nitrates, chlorides, perchlorates and sulfates. Insoluble salts are the oxalates, carbonates, hydroxides, oxides, phosphates, and fluorides.

THE RARE EARTH GROUP

TABLE 1

In the classification of the elements, the rare earths have atomic numbers 57 through 71; their names and numbers, together with those of yttrium and thorium, are as follows:

Atomic Number	Element	Atomic Weight
39	Yttrium	88.92
57	Lanthanum	138.92
58	Cerium	140.18
59	Praseodymium	140.92
60	Neodymium	144.27
61	Promethium	(145)
62	Samarium	150.43
63	Europium	152.0
64	Gadolinium	156.9
65	Terbium	159.2
66	Dysprosium	162.46
67	Holmium	164.94
68	Erbium	167.2
69	Thulium	169.4
70	Ytterbium	173.04
71	Lutetium	174.99
90	Thorium	232.12

The rare earths occur in more than 100 mineral types, but the only commercial minerals of importance are monazite and monazite sand, and bastnasite. Monazite is a thorium-rare earth phosphate which is recovered from placer deposits derived from some types of acid granites. Pegmatite deposits of monazite are rare and with one exception are generally not of commercial size. Monazite sands are obtained from placer deposits in North and South Carolina and Idaho and from beach sands in Florida, Brazil, and India. The most important source of monazite today is a vein type deposit in the Union of South Africa.

Bastnasite is a rare earth fluocarbonate mineral which contains only very small amounts of thorium. It is found in several parts of the world, notably in California.

In both bastnasite and monazite ores, the rare earths of lighter atomic number are most abundant with cerium accounting for about half of the rare earths present. Table 2 gives a typical composition of rare earth oxide extracted from monazite.

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The Aerosols

• By **Joseph A. Feldman, Ph.D.,** *(University of Wisconsin)*, ***and***
Mervin A. Kendall, B.S. in Pharmacy, *(Duquesne University)*
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Insecticides, sun-tan lotions, paints, room deodorants, shaving creams, cosmetics and many other common products are now packaged as aerosols.

There are many interesting applications of the basic principles of science in the aerosol package. This modern method of packaging offers many interesting illustrations of the laws governing the states of matter.

Mr. Kendall received his Bachelor of Science in Pharmacy from Duquesne University in June 1957. Doctor Feldman is an Assistant Professor of Pharmaceutical Chemistry.

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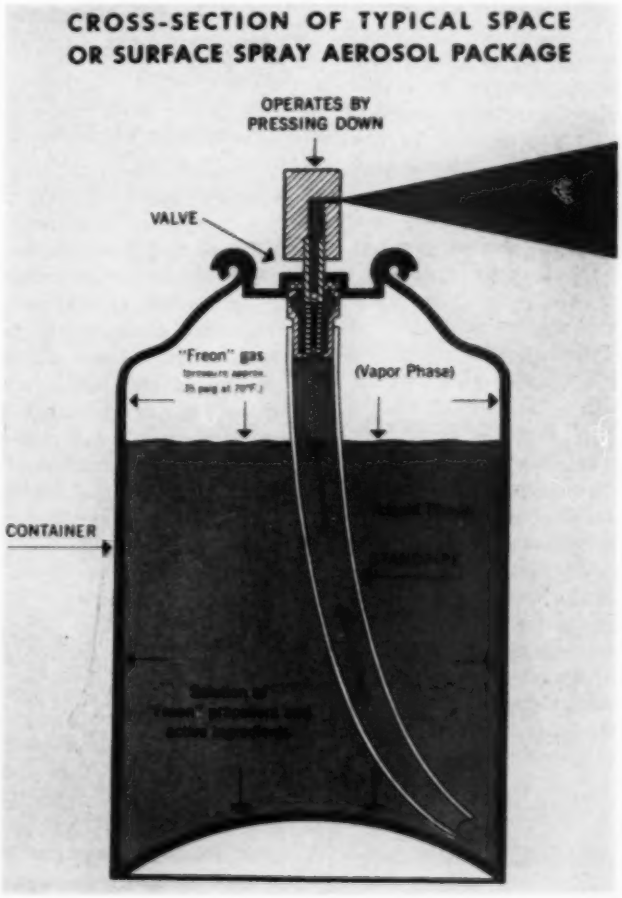
The items that are classified as aerosols cover many facets of use. These items include insecticides, paints, deodorants, shaving creams, hair sprays, and many others including whipped cream. You will find in this partial list many classes of items which are sold in pharmacies, supermarkets, and neighborhood variety stores. With the increasing number of new products packaged as aerosols, this form of packaging is of current interest. It is our purpose, therefore, to acquaint you with the background, the possible future, and especially the basic principles concerning this area of packaging or dispensing which has been classified as aerosol.

The technical definition of aerosol is "a suspension of fine solid or liquid particles in air or gas." Through usage this term includes all products that are dispensed from a container by a compressed gas or a compressed liquefied gas although no suspension of particles in air may be involved such as shaving lather.

In spray-type aerosols the size of the particles varies with the product. However, the U. S. Department of Agriculture defines insecticide aerosols on the basis of particle size. Their definition states that "all particles are less than 50 microns in diameter and 80 per cent by weight less than 30 microns in diameter." For some idea of this size, 847 particles which are 30 microns in size when laid side by side will cover a length of one inch. In sprays other than insecticides, the particle size may be much larger, depending chiefly upon the product.

In 1947 the "aerosol" industry produced 5½ million units. Eight years later, 1955, about 237 million units were produced. The definition of aerosols has been expanded to include those in which large particles are dispensed from pressurized containers.

Courtesy of E. I. DuPont de Nemours and Company



Several decades ago, William W. Sullivan read a paper by a scientist from France who suggested that the ideal insecticide for plain spraying should be (a) non-inflammable, (b) non-toxic to man and animal, (c) non-staining, (d) practically odorless, and (e) lethal to mosquitoes in five to ten minutes. Sullivan, an entomologist working for the U. S. Department of Agriculture, worked with Lyle Goodhue, a chemist in the Department of Agriculture, to develop such a product. In their deliberations, Sullivan considered liquefied gases and Goodhue suggested dichloro-difluoro methane, a refrigerant, as the liquefied gas. Their next step was to dissolve pyrethrum oleoresin and sesame oil in the liquid refrigerant and to seal this mixture in a cool con-

tainer which was then attached to an old oil burner. Upon opening the oil burner, the pressure of the solvent forced the contents out in a spray, and this aerosol was found to be three times more toxic to mosquitoes and houseflies than a hand-spray of the same material. The aerosol was odorless, non-staining, non-toxic to man and animal, and non-inflammable. On July 29, 1941, Goodhue and Sullivan applied for a Public Service Patent to be assigned to the Secretary of Agriculture. U. S. Patent No. 2321023 was issued on July 8, 1943, and was assigned to the Department of Agriculture. All present-day manufacturers of aerosols must license under this patent.

In accordance with Section 4 of this license, aerosol insecticide formulations were pre-tested by the Pesticide Chemicals Research Section. On May 11, 1954, the U. S. Department of Agriculture cancelled Section 4 of the license. This means that any new formula not in government files must be tested by the manufacturer until the government requirements are satisfied. Industrial concerns with new or altered formulas now negotiate directly with the Pesticide Regulation Section, Pest Control Branch, U.S.D.A.

There are four basic types of aerosols, namely: (1) true or space sprays, (2) wet or surface sprays, (3) foam type, and (4) powder type.

1. True Aerosols or Space Sprays

Examples: insecticidal sprays and air deodorants.

Space aerosols are true aerosols with an interacting liquid phase. Active ingredients of products are sealed along with liquefied gaseous propellant. The liquefied gas has a natural tendency to vaporize and fill the headspace above the liquid level with gas, thus creating pressure in the container. A standpipe leads from the liquid in the lower part of the container or can to a suitable valve. When the valve is open, the pressure in the container headspace forces the product propellant solution up the standpipe and out the valve. The liquefied gas instantly expands from a liquid to a gas. In so doing, it blasts the active ingredients of the product into minute particles which form a characteristic spray. Within the container, any discharge of content lowers the liquid level and accordingly increases the headspace. Each time this occurs, liquefied gas from the remaining solution immediately vaporizes to fill this space and maintain a substantially constant pressure in the container until all the product has been dispelled. The spray resulting from the "blasting effect" described is composed of particles so minute that they will remain suspended in the air for long periods. The surface area of these particles is so great in relation to their volume that they constitute the most efficient type of spray for air deodorants, insecticides, or similar products which require extremely fine dispersion for activity.

2. Surface Aerosols or Wet Sprays

Examples: residual insecticides, paints, hair dressings, etc.

The particles in the dispensing of a surface spray are of the same magnitude as those which are found in space aerosols. However, the formulation of a wet spray is designed to yield a product having larger particle size. This is accomplished by using a smaller amount of the propellant in the formula and generally operating at a somewhat lower pressure. Hence, the intensity of the "blasting effect" is reduced to a regulated point where particles may attain greater size through coalescence. In surface sprays, finely-divided solid materials in a liquid suspension may in some instances constitute a portion of the formula, whereas in space aerosols, the ingredients are incorporated in true solutions.

3. Foam Products

Examples: shaving creams, hand lotions, shampoos.

For a foam-type product, an appropriate liquefied gas propellant is partially emulsified with, rather than dissolved in the active ingredient of the product. Again, a small portion of this propellant vaporizes to reduce pressure in the container. When a suitable valve is open, the emulsified contents are forced out. On leaving the nozzle, the liquefied gas in the formula expands, whipping up active ingredients of the products into foam. As with the previous type of aerosols, additional liquefied gas vaporizes within the container to fill the enlarging headspace and maintain a constant pressure. The consistency of the foam can be varied by altering the amount of propellant and types of active ingredients in the product formula.

4. Powder Aerosols

Examples: body talcs, foot powders, etc.

Products such as powders may be packaged with liquefied gas propellants of the same type used for true aerosols. However, the powder must be capable of being suspended in the liquefied gas propellant without lumping or the formation of a hard sediment. Upon release of the valve, the liquefied gas and the suspended powders are forced from the valve opening in the same manner as space sprays or surface sprays. The liquid almost instantly vaporizes as it discharges the powder, and with suitable valve adaptations, the powders are literally blown from the container on to the area to be covered. Because of the fine dispersion effected, very efficient distribution of the powder on the object to be covered is obtained.

The Container

In the manufacture of aerosols, the choice of the propellant and the filling of the container are of the utmost importance. Aerosol loading is done in either one of two ways: by means of pressurized equipment at room temperature or with regular ordinary packaging equipment. The ingredients, however, must be at sub-zero temperatures so that the propellant may be handled as a liquid. At sub-zero temperatures, the vapor temperature of the fluorinated hydrocarbons is very low, and thus can be handled in the open as any other liquid. With both the propellant gas and the active ingredients

at low temperatures, the formulations can be placed into the container on a rapid production line basis. As the sealed containers reach room temperatures, the propellant builds up the pressure desired for the dispensing of the contents of the container.

With products which are sensitive to low temperature, however, pressure filling must be employed. Such items as shaving cream, shampoos, and hand lotions come under this classification. This pressurized equipment actually converts the gaseous propellant to a liquid by means of pressure although room temperatures prevail. The propellants, fluorinated hydrocarbons, are generally furnished by two principal manufacturers. Freon and Genetron are trade names for a group of haloginated hydrocarbons having one or more fluorine atoms in the molecules. Freon is supplied by E. I. duPont deNemours and Company and Genetron, a competitive item, is manufactured by the General Chemical Company. Other companies are also entering this field. Both of the above products are used because of low toxicity and non-poisonous properties.

Essentially, aerosol containers are gas-tight packages made of one of the following materials: black iron, tinplate, drawn aluminum, glass or plastic, with valve closures. A standpipe extends from the valve to the bottom of the container.

There are certain tests which all aerosols should pass before being marketed. Primary ones are toxicity and flammability. Others are shelf life and corrosion tests.

Many formulations, in order to be effective, will necessarily contain known toxic or irritating ingredients—frequently in harmful concentration. Most toxicologists agree that the only practical approach to evaluating such toxicity is the use of categories of hazards. The U. S. Department of Agriculture has set up four categories of toxic hazards.

The Chemical Specialties Manufacturing Association advises that a manufacturer obtain the exact formulation of the product and consider what, if any, hazards exist. Hazards must be determined from the end formulation. It is relatively easy to classify the hazards by simple short-term animal tests. The four categories are: highly toxic requiring skull and crossbones labeling, the word "poison," an antidote statement, and additional instructions to minimize possible injury. Products in the second category, one-tenth as toxic as the first, do not require poison labeling, but do require specific warning statements. Products in the third category, one-tenth as toxic as the second, require a caution statement plus specific information about the hazards. Products in the fourth category, one-tenth or less toxic as the third, are regarded as comparatively free from danger and usually require no caution statement.

Toxicity should not be confused with suffocation due to excess propellant in the air. If oxygen concentration in the air is lowered by the addition of too much propellant, the consequences can be serious.

The major points of consideration are accumulation of vapors in the loading areas and accidental leakage of larger containers. Tests on toxicity with Freon by duPont show that these products can be considered to be less toxic than carbon dioxide (Freon 12, 114). Other Freons, 11 and 22, are equal in toxicity to carbon dioxide. Freon 113 is under some conditions more toxic than carbon dioxide, but is no more toxic than methylene chloride.

If new formulations include safe ingredients, there is no need for further toxicity studies. However, if active ingredients are new or where formulation differs from what is known, extensive tests on toxicity must be made. Some ingredients, not usually toxic, may become toxic when used in aerosol form due to the fineness of particle size, which may enable the product to reach the respiratory system which ordinarily is not reached by spray products or other large particle products.

As propellants decompose by heat, fire in the factory could cause decomposition of the propellant, and toxic concentrations of elemental fluorine and chlorine might accumulate.

Flammability tests are important for a number of reasons. Three types of tests for flammability are: the flame projection test, the modified tag open cup test, and finally the drum test. The flame test indicates how far a flame will extend beyond taper if the spray from an aerosol is directed towards the same. The modified tag open cup test indicates what will happen if there has been a leak, the propellant gas has evaporated, and the remaining liquid has been heated sufficiently to boil or evaporate excessively. The drum test indicates hazards that may result if one were to spray excessive quantities of different formulations in a confined space and what would occur if a flame were present. It also indicates the results of varying degrees of dilution of spray with air when there is a flame present. All three tests should be used together to give a better over-all check on the flammability of a formulation. A unit should be classed according to the lowest rating received in any of the three tests.

Even with safe propellants, the flammability of active ingredients and complete formulations must be considered. In non-aqueous systems, the product may become flammable when the concentration of the halogenated propellant falls below 75 per cent.

Corrosion and shelf testing determine the shelf life of a product that is pressure propelled. It is necessary to determine that no corrosion will occur from standing on a shelf under all conditions anticipated. To test this, a corrosion cabinet is used. The temperature of the cabinet is set at a point calculated to produce corrosion within the container that would normally occur in eight or nine months on the shelf of a store but because of elevated temperature could occur within approximately thirty days. After the test, the container is torn apart and tests are made on all parts of the container to see the effects of corrosion.

In packaging of foam-type aerosols, the factor of "overrun" or "per cent of overrun" must be considered. This term is used to indicate the volume of foam that

(Continued on Page 133)

Hot Coals And Clinkers

• By **M. Edmund Speare, B.A. & M.A.,** *(Harvard)*; **Ph.D.,** *(Johns Hopkins)*
EDUCATIONAL DIRECTOR, NATIONAL COAL ASSOCIATION

In spite of serious competition from natural gas, petroleum and many new sources of energy, coal will continue to be our major source of power for many years. In addition coal is gaining in importance as a source of chemicals.

This article discusses the present status of the coal industry and the career opportunities it offers to students.

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The American coal industry, basic to our economic life and indispensable in our daily living, is unique in the ebb and flow of Fortune. Even over the decades preceding World War II, and sometimes now, it is occasionally—and most fallaciously—called a dead or a dying industry. But as a fact, the history of our coal production over the past 150 years proves that the mythical phoenix which burned itself out at the end of each cycle and rose again from its own ashes with renewed youth and beauty, has "nothing on" American coal. Today it is our major source of power, energy, light and heat, and promises to remain so for many future decades, even if atomic energy should ever be made available cheaply enough to serve our ever-increasing needs for power. When that time comes, our vast coal reserves will help supplement the atom and not be replaced by it. To ambitious American youth, especially those whose minds are scientifically inclined and want to become engineers, no industry today in our country offers a finer future than that of coal mining engineering.

Fluctuations of fortune make a dramatic story of our coal production and consumption. A generation ago bituminous alone employed 600,000 miners; these are now down to a little over a third that number. The railroads which consumed some thirteen years ago over 132 million tons annually to power their locomotives, now need less than fourteen million tons for those trains still non-dieselized. Retail deliveries, a large part of which meant coal for heating needs, took 125 million tons in 1944, but required less than half that tonnage in 1956. Production of bituminous which from 1915 to 1930 averaged between 579 million to 460 million tons annually, dropped to a little over 309 million in 1932 because of loss of markets. Then came 1944 with a market that swallowed up 619½ million tons of bituminous alone. In 1947, the record year thus far in our present-century production, a grand total of 688 million tons of American coal were mined: 631 million of bituminous, 57 million of anthracite. By 1954, increasing competition from natural gas and oil, made bituminous production decline to 392 million tons.

Two years later, by 1956, with railroads still further dieselized and competition from oil and natural gas greater than ever, markets for bituminous alone required 500 million tons. The present estimate is that by 1960, both for our own needs as well as for the ever-expanding Canadian and over-seas markets (Europe alone took some 41 million tons in 1956, four times the 1954 figure), we shall have to produce at least 600 million tons of bituminous, and some millions of anthracite. Today our coal management is preparing for a possible production figure by 1975 of one billion tons of bituminous. We are ready for this tremendous tonnage. Of the total remaining coal reserves in the world, the United States is blessed by Nature with the largest: 34.4 per cent of the world's total, and if we add Alaska, we own 36.4 per cent of that total. And geologists tell us that even at the present rate of annual production, our coal beds are so vast that we may continue mining coal safely for another thousand or more years. By contrast here are the World Power Conference percentages of coal reserves for the other more-important coal-bearing nations: USSR, 23%; China, 20.2%; Germany, 6.7%; United Kingdom, 3.4%; Poland, 1.6%; Australia, 1.1%; France, 0.2%; India, 1.3%; Czechoslovakia, 0.4%

Though this variation of fortune cannot be called a story of rags and riches, it

THE CONTINUOUS MINING MACHINE. It does the work, automatically, of four ordinary machines: cutting, drilling, blasting, and loading. This machine rips the coal directly from the "mine face", and loads the broken coal into waiting shuttle cars. Or, it may dump the broken coal into long conveyor belts, which move the run-of-mine coal to the Cleaning Plant. Some of these continuous mining machines—the most recent Joy Miner called the Twin Borer, weighing 79,240 pounds, with an overall length of 27 feet—can produce coal at the amazing rate of eight tons per minute. *Courtesy Joy Manufacturing Co.*

may perhaps, without forcing our metaphor too much, call it "from hot coals to clinkers"—from a state of clinkers in a household furnace to the hot coals which, through coke today, supplies 111 million tons of bituminous annually to make the manufacture of steel possible, or through well over 155 million tons of bituminous yearly, and more millions needed annually, for still greater electrification, to make possible the ever-increasing expansion of our electric utilities. Bituminous coal is now the source of more United States electric power than that supplied from all other fuels.

JOY CONTINUOUS MINER in operation at the Buckhorn Mine at Johnson City, Ill., of Bell and Zoller Coal Co. This mining machine eliminates the traditional cycle of cutting, drilling, blasting and loading by ripping the coal directly from the face and loading it into waiting shuttle cars.

Photo by Jack Lyons, Zeigler, Ill., courtesy Bell and Zoller Coal Co.

The drop in man power in our bituminous coal mines, from the 600,000 of a generation ago, to the 422,000 miners in 1939, to the 220,000 productive miners of today, indicates not the lessening of coal markets, but rather the ever-increasing mechanization going on today, whereby costly machines and more highly-trained workmen produce many more tons per man-day than was ever possible in the days before the spectacular internal revolution in current mining technology. In 1900, the average tons per man per day was less than three tons. In 1956, the average man-day production in underground mines was 10.3 tons; in surface mining it rose to over 22 tons per man-day. A present-day wheel-excavator working in surface mines in Cuba, Illinois, lays bare coal seams 75 feet below the earth's surface, making possible a coal production rate of 30 tons per man-day. Greatest wonder of all in mining machinery of our day is the Continuous Miner (see photo). This steel dragon, 25 feet long and seven feet wide, combines in one continuous operation all of the steps—cutting, drilling, blasting, and loading, otherwise done by four different machines—in the cycle of coal mining, and produces from five to eight tons of coal torn from the coal "face" *each working minute*. At Cadiz, Ohio, the world's largest shovel, the "Mountaineer" (see photo), went into service in "stripping" operations of the Hanna division of Pittsburgh Consolidation Coal Company (one of the largest coal producing companies in the world), early in 1956. This $2,500,000.00 shovel, weighing 2,750 tons, standing as high as a 16-story building, has a dipper that takes a 60-cubic yard bite of shale, rock, and other "overburden" weighing 90 tons, *every 45 seconds*, until the full seam of coal is exposed.

What a far cry these amazing production machines are from the old pick-and shovel days of American coal mining!

The modernized coal mines of our day are mass production factories underground and aboveground, which means that today's coal miner is, for the most part, a very skilled operator of expensive mining machines. He works in an industry where 98% of all coal is cut mechanically, and where over 80% of it is loaded mechanically. Forty per cent of our coal miners are under 35 years of age, 75 per cent are under 50 years of age. A large percentage of them are high school graduates, and they work not in dark, forbidding, completely cramped underground passages, but in well-ventilated areas, under electric lights. Our miners are among the highest paid workers of any of the major industries in this nation. The current contract of Coal Management with the United Mine Workers of America makes a per diem basic wage rate of $22.25, each work day comprising eight hours, but the productive labor given by each miner is 6½ hours only, since the other one-and-a-half hours are considered "portal-to-portal" time and lunch time, for which the miner is compensated as if he were actually at work. The working-week is normally a five-day week; men who work on Saturdays are paid for time and a half; if they work on Sundays or holidays, they are paid double time. A 14-day vacation period is given by Management to all workers who have been employed for at least one year, and the coal operators gives each man $180 to finance this vacation. Men who have worked for more than two years get more vacation days—in Christmas and on December 31, and for these three non-working days Coal Management pays each man $40. There are of course variations more frequently on the up-side in this daily wage schedule. Electricians get $23.88 per day; machinists, $23.88; "face bosses" start on a $26.65 per day salary; fire-bosses get $24.45 daily. The average American miner nowadays, working the five-day week, obtains a weekly salary which runs from $110 to $133. Work overtime may increase this substantially.

Fringe benefits in the American coal industry, developed in the United Mine Workers of America Welfare and Retirement Fund, by royalties of 40 cents per ton paid into that fund by coal operators, has developed the most generous and complete industrial retirement fund now in operation in the United States. In the ten years, from 1946-1956, our coal management has paid into that fund, based on royalties for every ton of coal that is mined by our coal companies, a

SHOVELS FOR SURFACE OR STRIP MINING. World's largest shovel, The Mountaineer, went into service here early in 1956, at the surface mining operations of the M. A. Hanna Co., division of Pittsburgh Consolidation Coal Co., Cadiz, O. The $2,500,00 shovel weighs 2,750 tons and stands as high as a 16-story building. The dipper takes a 60 cubic yard bite weighing 90 tons. Its total lifting power is 250 tons, or the total weight of 166 automobiles. In operation, the shovel relies on 16 General Electric motors with a total rating of 9,000 horsepower. Total peak power demand of the shovel is 6,840 kilowatts, or enough power to light 5,200 average homes.

Courtesy Pittsburgh Consolidation Coal Co.

grand total of $1,036,650,955.00. The purpose of this huge sum, to which more millions are added annually, is to assure proper pensions for miners being retired, for medical care for themselves and their families, for benefits for widows and other survivors, and for workmen who are disabled. A miner who reaches the age of 60, and has worked for 20 years in coal mining, is pensioned off at $100 per month for the rest of his life. Throughout his working life and even after retirement, he and his family receive free medical care and hospital privileges. As for safety in coal mining; over 90 percent of our coal mines today have had no fatalities, and Management spends millions of dollars annually on measures to guard against accidents. Coal mining was infinitely tougher years ago than it is today. The coal miner's job is more than twice as safe today on a man-hour basis than it was ten years ago, and five times as safe as it was 40 years ago, in terms of tonnage mined. Of the 61,546 miners retired in 1956, and pensioned off on $100 per month, the average age was 63.8 years. They averaged 32.3 years of active service in the coal industry. More than 2,201 of these men had worked 50 years or longer in our coal mines, all with perfect safety. Tens of thousands of our miners have been employed for years in the production of coal, both above ground and below, with records of not even a minor injury.

For the young man who is interested in taking up the engineering profession for a life-work, there is no other industry in America where the application of one's efforts is subject to more variation and where individual inventiveness and ingenuity are challenged to a greater degree than in bituminous coal mining engineering. Or is better rewarded. Where, for one example only, can one find today a more challenging, broader, and more diversified application of electricity in all of its phases than in coal mining? A young man just out of an engineering university with the initial degree of Bachelor of Science (B.S.) will receive a beginning salary of $300 to $350 per month. If he has done graduate work, and has the M.A. degree, his initial salary may be $400 monthly. If he should be fortunate enough to have attained the Doctorate in Science (Eng.Sc.D.), his beginning salary may range from $500 and more monthly. Thereafter, as he gains experience and proves his worth to the company, and as his years advance his capability to undertake these more responsible positions, he may expect, if he becomes a fuel engineer, the salary of $12,000 annually; as a preparation engineer, $10,000 yearly; as full superintendent of mines, up to $15,000; or as chief mining engineer, $15,000 annually; and, if he is fortunate enough to reach the position eventually of full plant engineer, with maintenance and power plant his responsibilities, he may hope for a compensation up to $25,000 yearly. The opportunities in American coal mining for the young engineering graduate are infinitely varied.

How diverse are the challenges ahead of the trained young man in this vital and cumulatively-mechanized industry may be indicated, in part only, by the following needs. New mining machinery is being developed constantly, and men are needed to know how to handle these machines and processing equipment. Then there is the subject of transportation. The use of large cars and of rubber conveyor belts for the movement of underground coal, need development. Roof control by bolts is increasing safety (falls from roofs constitute one of the major causes of accidents), and more work is needed here. Ventilation is being constantly improved in underground mining, and still more understanding is needed about the principles of air flow. Sales require more engineers to see that the proper sizes and grades of coal are used correctly in the right equipment for efficient operation of plants. Some engineering graduates may prefer careers in business administration and industrial management, and that means dealing with the accounting, finance, and general staff on mining properties. Or, one may find one's best opportunities in the factory or maintenance shops. Once the young engineer arrives with the proper initial educational training, and has a firm foundation in the fundamental sciences, it is up to him to build a successful career as his experience grows, and he is able to use imagination, leadership, resourcefulness, initiative, and self-reliance.

There is a variety of means for discharging college expenses. Scholarships, loan funds, part time jobs, and

work during vacation periods can be made to go a long way toward covering the costs of an engineering education. A variety of funds are provided by coal companies at many educational institutions. These few examples are typical of the 125 and more scholarships provided by various corporations to help young men financially toward getting their full engineering training—My examples are taken from each of five important coal producing states.

Illinois. The Sahara Coal Company affords eight scholarships at the University of Illinois, each of $200 per year, which, with the small charges added to the students in this state-supported university, are adequate enough to help a young man in need of financial assistance. *Indiana.* The Enos Coal Mining Company has inaugurated the George Enos Memorial scholarships at Purdue and at Butler universities, to give aid to eight young men annually. *Kentucky.* Inland Steel Company awards two scholarships annually till a total of eight are reached, $400 per annum, at the University of Kentucky, to graduates of high schools in Floyd, Knott, and Pike counties of that state. *Pennsylvania.* The Pittsburgh Coal Company offers two scholarships of $350 each per year, to young men from the mining areas of that company. The Imperial Coal Corporation, operating in Johnstown, Pennsylvania mines, began in 1949 a program to award a $500 scholarship for a 4-year period to an employee or the son of an employee to study mining engineering in Pennsylvania State University. *National Coal Association* awards two scholarships, each of $500, to first year students in Pennsylvania State University, who plan to concentrate on fuel technology courses, a subject badly needing trained men for the coal industry, and in a university uniquely equipped to develop fuel technology engineers. *West Virginia.* The West Virginia Coal Association deposits $5000 each year with the engineering department of the University of West Virginia to provide eight scholarships in coal mining engineering . . . . Any one interested in what scholarships are available in coal mining should write for further information to the Director of Mining Engineering Education, or to the Educational Director, National Coal Association, Southern Building, Washington 5, D.C. Thirty colleges and universities in our country have accredited curricula in mining engineering, and these range from the University of Alabama, to the University of Wisconsin. The full list and other general information may be obtained by applying to the National Coal Association.

Colleges offering courses in mining engineering have similar admission requirements. A high school student interested in engineering, should plan his course carefully so that, when he graduates, he will have at least the following minimum high school credits: English, 3 years; Mathematics, 3 years; Physics, 1 year; Chemistry, 1 year. At most colleges there is a requirement of 15 credits for admission. This is equivalent to four or five lessons per week for a year for each credit. In addition, therefore, to the credits from the four basic subjects already mentioned, the remaining credits may be made up of Economics, History, Languages, Public Speaking, and others offered by the high school. A student may be certain that the Admissions Officer of any of the engineering colleges will be more impressed by the quality of the applicant-for-admission than by the quantity of his credits. Therefore, early assistance of the high school counselor and prompt application for admission to the college are advisable. At most colleges, a choice of the branch of engineering, such as civil, or electrical, or mining, need not be made until the end of the freshman year.

Those of high school age who are yet undecided about entering college to work for a mining engineering degree that may start their career in the coal industry, but are nevertheless interested in undertaking after high school graduation some one of the many well-paid positions in general coal mining, will find in our coal mining areas special high and vocational schools which offer courses leading to employment in the mines. There are such schools in Mapletown, Greene County, Pennsylvania; at the Smithfield Ohio High School, the Mt. Pleasant Ohio High, the Dillonvale Ohio High, and the Adena Ohio High, all sponsored by the Hanna Division of the Pittsburgh Coal Corporation, where there are full mining courses for youth of high school age; short courses in coal mining are given in the summer sessions of the West Virginia University; and mining extension courses under the auspices of that university are available in a variety of high schools in that state; certain high schools in Kentucky give such courses; the Alabama Mining Institute at Birmingham also offers such curricula.

Possibly typical of the courses offered in these high schools, running from the freshman to the senior years, were those of the Monongahela Township High School, at Mapletown, Pennsylvania. The actual mining courses comprised, each year, the subjects of geology, mine gases, ventilation, timbering, transportation, explosives, mining laws, etc. Alternate weeks were spent in shop work where repairs were made on mining equipment, and in the operation of shop machines. Young men were made familiar, in the mine maintenance shop, with

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Courtesy Red Jacket Coal Co.

MODERN HOMES of coal miners in Wyoming, W. Va.

Micro-Corneal Contact Lenses

• By **L. Lester Beacher, O.D., O.Sc.D.,** *(Northern Illinois College of Optometry)*
DEAN OF THE GRADUATE SCHOOL AND PROFESSOR OF CONTACT LENS THERAPY, INDIANAPOLIS UNIVERSITY, INDIANAPOLIS, INDIANA*

Here is an interesting discussion of the micro-corneal lens, one of the latest developments in the science of optometry.

The author has been engaged in the study of contact lenses for almost thirty years, and is the chairman of the Contact lens section of the New Jersey Optometric Association.

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In the March 1951 *Science Counselor* a thorough account was given on the subject of contact lenses from the birth of the idea in 1827 up to 1951. In this treatise I briefly stated the existence of corneal contact lenses and discounted their practical value, as at that time they had not met the approval of this writer, nor had they satisfied the patients who had been fitted with them.

As a result of further research to gain more consistent and longer wearing time with contact lenses, much has transpired in this field during recent years. As a result of the combination of all these efforts in the right direction, the advantages to the patients for whom we prescribe and fit contact lenses, fall in the category of greater usefulness. We now use almost exclusively a form of contact lenses, called "Micro-lens."

What is this micro-lens? It is a type of contact lens which is classified as a form of corneal lens, but extremely thin and smaller in size than the diameter of the cornea. It is a contact lens that rests only on the cornea and is generally between 8.5 and 9.5 millimeters in diameter, just large enough to cover the pupil under all conditions of illumination and extend beyond it for full usefulness. In thickness it ranges from 0.18 to 0.25 mm. They are plastic (methylmethacrylate). They are cast into forms and the prescriptions for them vary according to the refractive error of the patient and the corneal curves of the eyes.

Previously contact lenses rested on the scelera (the white portion of the eye), and a buffer solution was used in the corneal section. The buffer was a solution of a specific pH to conform to the tears, and it presented a chemical problem after the lenses were in use over an extended period of time. This was one of the reasons for the inability of most patients to wear the lenses beyond four or five hours a day. Later a "fluidless" sceleral lens, which was so constructed that it no longer required an artificial buffer solution, was developed. Instead the patients' own tears filled the corneal section.

The corneal lenses (including the micro-lenses) float on a thin layer of tears, between the cornea and the lens. For practical purposes, we merely refer to the fact that the lenses are "on the cornea." Technically speaking they are on a layer of tears over the corneal area. The tears between the lens and the eye are constantly renewed and they replace the previously used buffer solution.

As to appearance these micro-lenses, because of their thinness and extremely small size, are better than 99 per cent invisible. Detection is possible only upon extremely close examination at about two or three inches from the eyes.

The insertion and removal of the lenses is very simple, and is taught to the patient by the doctor. Like all skills, it may seem awkward until the technique is acquired. The technique is so simple that after several repetitions one gets the idea and henceforth there is no difficulty.

Micro-lenses, like all forms of contact lenses, do not need to be changed as frequently as regular spectacles. This is due to the fact that corneal astigmatism is corrected by the layer of tears between the cornea and the lens, and also because these lenses are so close to the eye. On the average persons who require lens changes in their spectacles every two years will hold on to their contact lenses for five years without a change. During the interim, their regular glasses (which they should retain as an auxiliary) will have to be changed and brought up to date.

As to safety, they are made of plastic. With these lenses a person is safer than a person with naked eyes, as the lens will reduce the impact of the blow and the effect upon the eye is reduced. With spectacles, the glass may cut the eye. With plastic contact lenses, including the micro-lens, we have greater protection. Properly fitted micro-lenses will create no ill effect upon the eye. Statistics bear out this fact. This can readily be understood, as the lenses, when properly fitted, do not actually rest on the cornea but float on the layer of tears between the cornea and the lens.

The wearing time is a major consideration, for which reason the micro-lens replaced almost entirely the scleral lenses. While this writer has been engaged in contact lens practice for nearly 30 years, it is only since 1954 that we can make definite promises to the patient. In about 75% of patients now fitted with micro-lenses, we find patients' wearing time from 10 hours per day upward, most of whom wear them all day, i.e. 14 to 16 hours. In many instances reports have come in from persons who had "extended days"

(Continued on Page 138)

* Present address, 564 Springdale Ave., East Orange, N. J.

Some Suggested References On Sex Education

From The Boston College *Scope*

The SCOPE *is an undergraduate journal published by the Biology Department of Boston College, and is edited by the Mendal Club. The following article appeared in the Spring 1957 issue. Because we believe that the information it contains will be of service to many of our readers, we asked for and obtained permission to publish it in the* SCIENCE COUNSELOR.

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Introduction

Today's parents, doctors and priests are facing a task of education never before experienced by their predecessors. In view of the huge amount of publicity given to hitherto private knowledge on marriage, sex, physiology and marital relations, adults and professional personnel are faced with the task of sifting the chaff of misinformation and misemphasis from the wheat of spiritual motivation and revealed truths. As an aid to those confronted with this task the following list of publications is suggested for doctors, priests, and professional workers engaged in the field of family guidance, for their own use and for the use of their patients, parishioners, and clients. This list is not an exhaustive one. It is made up of booklets and pamphlets written under both Catholic and secular auspices. Publisher or place of distribution is listed: price and pages are also mentioned when known. A moral evaluation of the contents is appended to each booklet. This will give some idea of content and age group for whom the booklet was intended.

References

With few exceptions the books listed are intended for the use of adults, not children. The doctor or the priest or counselor who might have occasion to use them should use them with an eye to placing the burden on the *parent*. It is Catholic teaching that the prime responsibility for sex education rests on the parents who should be assisted in teaching their child, in the privacy of the home, what knowledge is necessary, in the light of age and emotional stability.

The first two references are booklets presenting an extensive treatment on matters of sex and Catholic morality.

Kelly, S.J., Rev. Gerald, "Modern Youth and Chastity." The Queen's Work Press, 3115 South Grand Boulevard, St. Louis 18, Mo. Price: 25 cents. Pages: 108. Available at bookstores and bookracks.

A superb, comprehensive pamphlet, on senior high school and college level, on matters involved in the teaching of sex education and chastity. This booklet will give the Catholic adult a solid knowledge of Catholic moral theology in this matter.

Sattler, C.S.S.R., Rev. Henry V., "Parents, Children and the Facts of Life." St. Anthony Guild Press, Paterson, New Jersey. Price: $1.75 (paper bound). Pages: 256. Available at bookstores and libraries.

This book provides a thorough coverage of moral teaching on sex education. Its approach, however, is from the "case method" theory of teaching, using examples and model problems. This is a fine teaching system but each reader must use it with a knowledge of its limitations. Cases are given and solutions suggested. Actual cases may not be the same or open to the same solution. In matters of conscience, each parent or counselor should take the case to their priest.

The following references are pamphlets which give the parents actual instruction in the method of informing their children about the sexual instinct and the anatomy or physiology of the sexual systems.

Lyman, Edward, "Let's Tell the Whole Story About Sex." American Social Hygiene Association, 1790 Broadway, New York 19, N. Y., Free or at a minimum price. Available through the office of Dr. Nicholas Fiumara, Div. of Venereal Diseases, Dept. of Public Health, 15 Ashburton Place, Boston. Pages: 30.

This is a model conversation between mother and daughter, and father and son, on the process of birth, menstruation, adolescence, and the marriage union. It is excellent in every way although the situation is a bit idealized for the experience of the average parent.

"Christopher Record on Sex Instruction," published by the Christophers, 18 East 48th Street, New York 17, N. Y. One LP record for $1.50 or four 78 RPM records for $3.00. The LP consumes forty minutes.

The pamphlet and the recording are intended for *parents'* listening. They may then make adjustments to suit the needs of their own children.

Bruckner, S.J., Rev. P. J., "How to Give Sex Instructions," The Queen's Work Press, 3115 South Grand Boulevard, St. Louis 18, Missouri. Price: 25 cents. Available at bookstores, and pamphlet racks.

An excellent manual for parents, giving model instructions for both boys and girls, with case examples and problems. A Catholic spiritual viewpoint is maintained throughout. Intended for adults.

"Mother's Little Helper," Franciscan Herald Press, 1434 West Fifty-first Street, Chicago 9, Illinois. Price: Fifty cents. Also available at Catholic bookstores.

This is a series of model talks, to be read by the mother to her daughter. It is given in three sections, according to the age of the daughter, from age nine to eighteen. It is less factual than Fr. Bruckner's pamphlet, more discursive. Parents reading the talks will

find no difficulty in rearranging them to suit their own needs.

The following publications are written for a secular, non-Catholic audience. They give their teaching in an impersonal manner, based on a naturalistic philosophy of living. Most of the information and advice is sound but unsatisfactory. These publications are included because of their excellent information on the biology of the male and female. No known Catholic publication yet gives this detailed information. Charts of tasteful design are included and picture-methods of teaching are employed. They supply an important supplement to the books already written under Catholic auspices. They must always be used in conjunction with Catholic publications. If used alone, they may be misleading and secularistic.

"Facts Aren't Enough," American Medical Association, 535 North Dearborn St., Chicago 10, Ill. Also available through the National Education Association, 1201 Sixteenth St., N.W., Washington, D. C. This is the fifth in a series of five pamphlets on Sex Education sponsored by the AMA and the NEA. Pages: 75.

This pamphlet is written for the parent. It refers to problems of children from age nine to twenty-one. It includes a fine naturalistic background for the existence of the sexual instinct, and charts and diagrams illustrating the sexual organs, conception, and the process of birth. It also goes into adolescent psychology, times to talk about sex, events common in most homes that will serve as springboards for sex talks. Advice to girls on dress and dancing is sound. A bibliography of sex education pamphlets and books is appended.

Kirkendall, "Understanding Sex," Science Research Associates, Inc., 57 W. Grand Ave., Chicago 10, Ill. Price: 25 cents. Available through some bookstores and newsstands. Pages 50.

This booklet is meant for the reading of the adolescent. It has all the reservations referred to under "Facts Aren't Enough." It disapproves of masturbation, pre-marital sex relations, etc., but on a naturalistic basis. The older adolescent (above fifteen) will appreciate its "grown-up" approach.

"Very Personally Yours," Educational Department, International Cellucotton Products Co., 919 North Michigan Avenue, Chicago, Ill. Available in quantities from local Departments of Public Health, or from the company. Pages: 21.

An excellent help for the doctor who wishes to save time in explaining menstruation to the parent or child. A brief pamphlet with clever and clear pictures and sketches explaining in simple and reverent terms the entire process.

"The Gift of Life," Health Education Service, P. O. 7283, Albany, New York. Approved by the Religious Advisory committee of New York Department of Public Health, (A minister, rabbi, and priest). Available from the above address. Price: 25 cents. Pages: 30.

This is a pocketsize, flip-over type of booklet giving the story of human growth, boy and girl physiology, and the biology of conception. The story is told in thirty impersonal charts, forming a fine teaching method for parents' use as pictures in describing the process to children. Very discreetly done.

The following publications are intended for those interested in pre-nuptial instructions. They are written for engaged couples or for the more mature adult.

"Preparation for Marriage," a 15 lesson correspondence course under Catholic auspices. The Catholic Centre-MPS (i.e., Marriage Preparation Service) 1 Stewart Street, Ottawa 2, Canada. Given in first installment of ten lessons. The last five lessons, due to their personal nature, will not be sent unless the request is signed by a priest. Total cost for 15 lessons is $7.00.

This is recommended as the best available premarriage course. It covers all the fundamentals in a reverent manner, using the Catholic faith as a basis for all the teaching. It is, to the best of our knowledge, the only course of its kind available.

"Beginning Your Marriage," Delaney Publications, 200 South Grove Avenue, Oak Park, Illinois. Price 50 cents. This pamphlet of 100 pages will be distributed to the clergy only. An imprimatur by Cardinal Stritch of Chicago. Published by the Cana Conference of Chicago.

For engaged couples, or mature adults contemplating marriage, this is the best available booklet, giving the Catholic philosophy of marriage, together with chapters on the physiology of both male and female and a description of the marital act. To our knowledge, it is the only booklet of its kind available, though under restrictions. Because of its discussion of such facts as impotence, the initial act, love play, and the rest, it is an excellent antidote for some of the information given under these titles in popular magazines. It can, with little reservation, be recommended as strongly as possible to all engaged couples. The newly married will also find the booklet a source of information for themselves.

Bowdern, S.J., William S., "Problems of Courtship and Marriage," The Queen's Work Press, 3115 South Grand Boulevard, St. Louis 18, Missouri. Price: 25 cents. Available at most bookstores and pamphlet racks. Pages: 62.

This is a fine theological explanation of some of the problems of engagements and marriage, directed towards the young adult group. In the last chapter it gives a brief explanation of the legal and ecclesiastical steps necessary before marriage. Prohibitive and diriment impediments, content of the marital contract, necessity of the banns, and grounds of nullity are all explained.

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More than 3,500 books have been sent as gifts to replenish the children's library in atom-bombed Nagasaki, as a result of a campaign led by a United States citizen, Mrs. Albert Hester, of Cincinnati, Ohio. The library was created by the late Dr. Paul Takashi Nagai, a well-known Japanese scientist.—(UNESCO)

Emerging Problems In Driver Education

• **By Amos E. Neyhart, M.S.,** *(The Pennsylvania State University)*
ADMINISTRATIVE HEAD, INSTITUTE OF PUBLIC SAFETY, THE PENNSYLVANIA STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA

Highway safety demands that young drivers be trained not only in the operation of the automobile but also in the rules of safe driving. High school administrators must realize that every student either drives or in all probability will soon be a driver.

The author, an expert in the field of driver education, is a consultant on Driver Education to the American Automobile Association.

This paper was given at the Driver Education Section of the Pennsylvania Education Association meeting, October 12, 1956.

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Just what is the *present* status of driver education in the United States? In 1956, of the nation's 19,886 public high schools, 10,270 offered driver education courses enrolling 923,830 students out of a potential of 1,652,816 youngsters. The fact that over ten thousand of the Nation's schools provided this vital area of instruction, enrolling almost one million students in one year, is most encouraging!

But let us consider the types of courses provided. The picture here is not so bright. Eighty-three per cent, or 8,519 of the courses provided by schools were composed of both classroom and practice driving, while seventeen per cent, or 1,761 were composed of only classroom instruction.

Fifty-eight per cent or 527,441 of the students enrolled in driver education courses received both classroom and practice driving instruction and forty-two per cent or 396,390 were enrolled in only the classroom work.

This means that we have some hard work ahead of us. We are the ones who set up minimum standards when we inaugurated our first courses, we are the ones to contact the school officials in our territories in an effort to establish and maintain high standards. If such standards are not maintained, the students taught in our high school driver education courses will have no better accident record than those not so taught. If this happens, our major objective of developing good drivers through the high school courses will not have been attained.

At this time, I would like to enumerate and comment briefly on five emerging problems in driver education. I will give these problems in positive statements because that is the way we plan to attack them. Here are my ideas:

1. Stimulate more widespread acceptance of driver education *among leaders* in education.
2. Reach *all* eligible students at the appropriate age-grade level.
3. Increase the effectiveness of our teaching on both the college and high school levels.
4. Encourage more pure research.
5. Improve the community relations aspect of driver education.

Stimulate More Interest Among LEADERS in Education

And now, I will comment briefly on these statements. Just recently, when I was teaching on the West Coast, I learned that the Superintendent of Public Instruction in one of our important states still believes that classroom instruction is all that is necessary to develop good drivers. We will never have an outstanding driver education program in this state until this individual in such a key position changes her ideas about the importance of the practice driving part of the driver education course.

In one of the large cities in the same state, the Superintendent of Schools spent several hours at a banquet telling a driver education teacher why the schools should not have taken on this added responsibility. The superintendent didn't know he was talking to one of his own teachers. It was now crystal clear to this teacher why driver education has made such slow progress in his city. The superintendent doesn't believe that driver education has a place in the school program, so he does everything that he can to retard its progress.

The Assistant Superintendent of Schools in a large city in the southwest just wrote a letter to the School and College Division of the National Safety Council, asking for more information on the change in attitude of the practice driving instructors. He understood that these teachers now felt that behind-the-wheel instruction was unnecessary. This is far from the truth and he was told so by an official of the Council.

Our job is to contact the top educators on both state and local levels to stimulate more widespread acceptance of driver education among such leaders in education.

We are available to make personal contacts and conduct conferences for school administrators. When we are fully informed, we usually accept the new.

Reach ALL Eligible Students

At the present time, a number of our high school courses reach only a limited number of the senior class. This is not the desirable age level to enroll in these courses. The best time is when the students are legally old enough to drive, or better still, through appropriate legislation to start the classroom and practice driving at least six months in advance of the legal driving age, providing the instruction is offered by the high schools and meets state standards. This plan gives the schools

an opportunity to develop good attitudes, understandings, and appreciations toward traffic before the students learn to use unsound and unsafe practices if taught by parents or others.

Our goal should be to reach all eligible students at the appropriate age-grade level. Personal contacts made by you will help in this direction.

Increase Effectiveness of Both the College and High School Courses

The effectiveness of our teaching on both the college and high school levels is reflected in the driving records of the graduates of our high school courses. At the present time, we have college professors offering teacher preparation courses in driver education who have never taught a single driver how to drive. And further, they do not require their teachers to instruct at least one student from "scratch" how to drive under their immediate supervision, and what is worse, they completed one forty-hour college professors seminar and now feel that they are traffic experts.

We are trying to remedy this situation in Pennsylvania by offering each year a two-day College Professors Problems Clinic in Safety Education at Penn State. This Clinic is sponsored by the State Department of Public Instruction, The Pennsylvania State University and the Pennsylvania Motor Federation.

We offer a similar conference for the college instructors in Southern California. This program is sponsored by the college instructors in Southern California and the Automobile Club of Southern California.

In addition, we assist the college instructors with their courses as much as time permits in an effort to help upgrade the teaching on the college level.

The teaching of driver education on the high school level also presents certain problems. Thirteen states do not require the successful completion of an approved teacher preparation course in driver education for teachers of both parts of the program. This means that school bus drivers, mechanics in garages, traffic officers, and others who are not teachers often teach the practice driving part of the program.

Seventeen states do not require the possession of a valid driver's license for teachers of both parts of the program. This means that many of our classroom teachers do not even drive a car. They are seriously handicapped when it comes to answering students' questions when the students not only drive, but are well-informed on traffic matters.

Here again we have a task ahead of us in making courses, conferences, and seminars available to college and high school instructors in order to increase the effectiveness of our teaching on both the college and high school levels.

There is another emerging problem at the present time in Portland, Oregon whereby practically all practice driving will be handled by commercial driving schools at a certain fee. The Superintendent of Schools in Portland has gotten the school board to pass a resolution allowing the schools to release students for such behind-the-wheel instruction. The scheduling of students and collection of fees will be handled by each commercial school.

The schools assume no responsibility for this program. The promoter of the plan calls it the National Foundation for Driver Education and intends to make it National in scope. Here is a good example of the schools "passing the buck."

Based on our experience, this is certainly not the way to teach the practice driving part of the course. If such a program is adopted, we will be moving backward instead of forward.

Encourage More Pure Research

We progress in these traffic matters according to the data and information available from research studies. There is still much to be done in this field. We still need answers to such questions as: Why do drivers try to cover 600 miles after a hard day's work without rest? Why do drivers operate their vehicles after drinking? What is the best approach to use in developing good driver attitudes? How much time should be spent on practice driving as compared with the classroom part of the program? What teaching methods can be used to reduce the time spent on practice driving? What is the ideal plan for financing driver education? These and many more questions remain unanswered.

It is through research studies that we will seek the answers to our many questions in this field. You should do everything possible to encourage such studies at colleges and universities in your territory. The AAA has announced a grant of $50,000.00 made to Columbia University to conduct a study on driver behavior. We need more such grants and more institutions of higher learning conducting such studies.

Improve Community Relations

One of the most important tasks ahead of us is to get community support for the driver education program. When the community is "sold," there is no problem in securing driver training cars, financing the course, scheduling or securing the needed equipment. There are usually good programs where we have outstanding and dynamic leadership.

Two things have happened nationally that will have far reaching effects on the future of driver education. One is the insurance savings on premiums now offered by a number of insurance companies, if the students complete a standard course in driver education including both classroom and practice driving. The other, the driver training car set-up announced by General Motors Corporation, Chrysler Corporation and the Ford Motor Company. For every new car loaned to schools for driver training classes, these manufacturers will provide a special allowance of $125.00 to the dealer. This plan should encourage the expansion of the practice driving part of the program.

(Continued on Page 134)

National Educational TV Project

General Background

Continuing the joint effort started last spring, the National Broadcasting Company and the Educational Television and Radio Center will cooperate again this fall in presenting national live programming for the Center's affiliates. The Center will be underwriting the costs of two series—one on government from Washington, D. C., and the other on the International Geophysical Year. The Center is continuing to carry the costs of connecting stations with the NBC transmission lines.

NBC will underwrite costs of producing the three other series—one in the field of mathematics, another in the area of world resources and a third in Greek Mythology as related to the creative arts.

The live broadcasts, as in the spring, originate in New York and Washington. They began October 28 and will continue for ten consecutive weeks with a different series to be broadcast each night of the week at 6:00 p.m., Eastern Standard Time. The order of the series will be as follows:

Mondays	International Geophysical Year
Tuesdays	Mathematics
Wednesdays	The Arts and the Gods
Thursdays	Survival
Fridays	Camera on Washington

At NBC, the project is a part of the work of the Public Service Programs Department. Edward Stanley is head of that division.

The executive producer of the project is Brice Howard of NBC. Donley Feddersen, program associate for the Center, is the ETRC's representative on the total project.

The five series will be picked up by the following non-commercial educational stations which are affiliates of the Center (some NBC stations also will carry them on a delayed basis).

WGBH-TV, Boston, Massachusetts
WUNC-TV, Chapel Hill, North Carolina
WTTW, Chicago, Illinois
WCET, Cincinnnati 10, Ohio
WOSU-TV, Columbus 10, Ohio
KRMA-TV, Denver, Colorado
WTVS, Detroit, Michigan
WKAR-TV, East Lansing, Michigan
KUHT, Houston, Texas
KUON-TV, Lincoln, Nebraska
WHA-TV, Madison, Wisconsin
WKNO-TV, Memphis, Tennessee
WTHS-TV, Miami, Florida
WJCT, Jacksonville, Florida
WTIQ, WBIQ, WAIQ, Alabama Network
WYES, New Orleans, Louisiana
KETA-TV, Norman, Oklahoma
WQED, Pittsburgh, Pennsylvania
KQED San Francisco, California
KCTS-TV, Seattle, Washington
KETC, St. Louis, Missouri
WILL-TV, Urbana, Illinois
WMVS-TV, Milwaukee, Wisconsin
KTCA-TV, St. Paul, Minnesota
KUED, Salt Lake City, Utah

International Geophysical Year
(A Small Planet Takes a Look at Itself)

Each program will constitute a complete, self-sufficient program on a particular part of the I.G.Y., the huge world-wide scientific study which began this year. The most significant features of present knowledge and information on the planet earth will be explained and illustrated fully.

With the information that is known about the earth as a framework, the programs will then attempt to show the gaps in knowledge about natural phenomena and illustrate how scientists will fill those gaps. A considerable percentage of each half-hour will be devoted to demonstrations with models and to film coverage of key I.G.Y. activities.

A number of leading scientists who are participating in the International Geophysical Year work will be guests on the series. Among them:

. . . Dr. Joseph Kaplan, department of physics, University of California, and chairman of the executive committee of the U. S. National Committee on the International Geophysical Year . . .

. . . Dr. Lawrence Gould, chairman of the U. S. National Committee's Antarctic Committee. He is president of Carleton College, Northfield, Minn. . . .

. . . Dr. Marcel Nicolet, secretary-general of C.S.A.G.I. (A special committee for the IGY) . . .

. . . Dr. Roger Revelle, Director of the Scripps Institution of Oceanography and a member of the Oceanography Committee of the U. S. Committee on the IGY . . .

. . . Father J. Joseph Lynch, Fordham University, seismologist with the U. S. National Committee of the IGY . . .

. . . Lloyd Berkner, Associated Universities, Inc., and longtime scientific administrator who was on the first Byrd Antarctic expedition, U. S. Representative to the international committee of the IGY . . .

. . . Dr. Walter Orr Roberts, director of the High Altitude Observatory at Boulder, Colorado . . .

. . . Dr. Homer E. Newell of the Naval Research Laboratory . . .

Frank Blair, one of NBC-TV's best known news commentators, will serve as host of the series. He has become well known to viewers of NBC's "TODAY."

Program titles include "The Quest," which will introduce the series: "Antarctica"; "The Face of the Land"; "The Trembling Earth"; "The Oceans"; "Oceans of Air"; "The Atmosphere"; "The Virgin Sunlight"; "Higher Than the Blue Sky"; "The Earth from Space."

Models of the satellite which will be launched as a part of IGY will be shown. Other tools to be used in the huge study also will be depicted.

(Continued on Page 130)

Time Signals From Bureau Of Standards Radio Used By Teams Tracking Russian Satellite

When American scientists began tracking the Russian satellite, they relied on the broadcasts of a little-known government radio station for coordinated timing. The tracking stations used the time signals regularly broadcast by Station WWV at Beltsville, Md.

Tracking teams will also use the WWV signals when the United States launches satellites of its own. In its everyday work, WWV helps keep the country's clocks on time, its musical instruments in tune, and its broadcast stations in their channels. It also makes possible the accurate use of radar.

The station and a twin (WWVH) in Hawaii are operated by the Boulder (Colo.) Laboratories of the National Bureau of Standards, Department of Commerce. Dr. Allen V. Astin, Director of NBS, pointed out that the stations make available the standards of time, radio wavelengths and musical pitch in every American plant, laboratory and studio that needs them. They also tell the users of short-wave radio what the outlook is for broadcasting conditions, and during the International Geophysical Year notify scientists of periods when their observations should be intensified.

A piano tuner in Ohio, by dialing WWV on his short-wave receiving set, can find out whether his tuning fork is on pitch. Meanwhile a watch manufacturer in New York is checking his inspection instruments for accuracy, a Navy gunner is finding out why he missed a target, and the manager of a power station is bringing his output to a true 60 cycles per second. If the house current cycles are off, the electric clocks in the area will be off too.

Government, university and private research laboratories rely on WWV. If there were no WWV, many an industrial organization would have to maintain its own source of time measurements at a high cost. Organ manufacturers would have to make some other arrangements to be sure their products were on key.

WWV guarantees accuracy of its broadcasts to within one part in 100 million. This is about the accuracy of the earth itself as a timepiece; because the earth varies a little in the regularity of its revolutions on its axis during each year.

Consternation When It Stops

Although WWV is maintained for United States users, its short-wave messages bounce around the globe. In 1954 Hurricane Hazel cut off the power for seven hours, and protests at the interruption poured in to the National Bureau of Standards from all over the world. Once when the power of one of the six transmitters was intentionally lowered, the French Embassy reported that this was preventing completion of a series of measurements in France. WWV kept the same power on this frequency until the experiments were over.

The station now has gasoline engines and generators for emergency use in case of power failures.

Twenty-four hours a day WWV answers unspoken questions such as these: What time is it? Exactly how long is a second, a minute, two minutes, three minutes, five? What is Note A above middle C? Can we reach London by short wave this afternoon? Will my station's broadcast signal be heard today?

A Busy Hour

In the course of every hour, WWV broadcasts twelve voice announcements of Eastern Standard time, twelve code signals of universal time, six periods of an audible tone at 600 cycles per second, five periods of a lower audible tone at 440 cycles per second (A above middle C), two predictions of short-wave radio conditions, two signals about the International Geophysical Year, and one four minute period of silence. All through the hour (except in the period of silence), ticks mark off the seconds. To indicate the end of a minute, the 59th tick is omitted, and there is a double tick at 60 seconds.

The voice says cheerfully, "National Bureau of Standards, WWV; when the tone returns, Eastern Standard Time is . . ." and adds the figures and "a.m." or "p.m." To the staff members at WWV, it is a familiar voice but unknown. It came recorded on a machine bought from an Atlanta manufacturer. The instrument neatly splices three records every five minutes to give the complete announcement; after the introduction come, for instance, "nine five" and "a.m."

The universal time (UT) is sent in International Morse code. (Universal time is the same as Greenwich Time, and is based on Greenwich, England, Noon Eastern Standard Time is 1700 UT.)

The 600-cycle audible tone can conveniently be converted by electronic instruments into other frequencies. For example, it can be divided by 10 for comparison with the customary 60 cycles of household circuits.

The 440 cycles per second would be recognized by a musician as A above middle C, the standard musical pitch in the U. S. Before it was supplied by WWV, musicians and maufacturers of musical instruments had to rely on standard tuning forks or organ pipes, both of which were affected by temperature changes. The WWV staff has been told that symphony orchestras and individual musicians rely on the musical tone.

Radio Forecasts

Predictions of short-wave conditions are made in "radio propagation forecasts" that are issued every six hours. The NBS North Atlantic Radio Warning Service at Fort Belvoir, Va., near Washington, telephones the latest information to the staff at WWV. The forecasts are then transmitted automatically and report the expected condition for the next six hours

of the ionosphere—the ceiling of electrified gases high above the earth from which short waves are reflected. The predictions tell the State Department whether it will be able to send its messages without interruption to London and Berlin. They also give the radio broadcast networks a chance to plan their live broadcasts from correspondents abroad.

Twice each hour, like the radio forecasts, code reports for IGY scientists go out from WWV. A period of "alert" is designated whenever the sun is so active as to create conditions scientists will want to study. During the alert period, a "special world interval" may be announced, for instance, when a magnetic "storm" seems probable within a few hours.

Even the four-minute period of silence each hour has its purpose. The channel thus left vacant, which is not used by any other American broadcaster permits the measurement of atmospheric noise.

Millions of Cycles Per Second

WWV is housed in a one-story, high-ceilinged brick building, set among clusters of antenna poles on twenty acres of land near Beltsville, Maryland. The site is near the Department of Agriculture's large research center.

The visitor is struck by the relative shortness of the wooden poles that carry WWV's antennas. From 20 to 100 feet high, they are proportioned to the six different wave-lengths used and are diminutive compared to the high towers used by commercial broadcast stations.

WWV broadcasts on standard radio frequencies of 2.5, 5, 10, 15, 20 and 25 megacycles (millions of cycles per second). The lower frequencies provide service over short distances and the higher over great distances. It is these frequencies that are used by commercial broadcasting stations to check whether their own frequencies are within the channels assigned to them. By means of electronic equipment, industrial plants, government and research laboratories can use these six to measure other frequencies.

Including a standby, station WWV has seven transmitters.

The Crystals in the Well

The frequency and time signals are controlled by a crystal vibrating at the bottom of an air conditioned well. Twenty-two feet below the floor of the station is a tiny room, kept cool and dry, in which a piezoelectric quartz crystal vibrates electrically at the rate of 100,000 cycles per second. Through electronic multiplication and division, this crystal controls all the frequencies down to one (the second ticks) and up to 25 million cycles per second.

There are really three crystals in the well—one in use, one in standby, and one spare. Twice each hour the frequencies of all three are compared against a reference crystal as a check on their accuracy. The crystals were put in the well to shield them from noise, vibration, and temperature variations. When an engineer has to enter the well for serving work, its temperature may rise one half a degree or more.

Crystals have an indefinite life, but are being continually improved and replaced. Two, the oldest at WWV, have been in use about twelve years, one about four years.

Special Sets to Tune in the Station

Several manufacturers make radio sets solely for the reception of WWV. These sets will receive several or all of the six standard frequencies. Some of the sets come equipped with oscilloscopes. These are instruments that show what a radio wave looks like and help in many types of measurements.

Why is the length of the second so important? scientists may be conducting delicate laboratory experiments that depend on it. Electronics manfacturers need it to calibrate their instruments. Radar operators need it in order to calculate the distance of an object. The number of yards to a target is indicated by the time it takes the radio waves to reach it and be reflected back. As they move at 186,000 miles per second, an accurate time interval is a highly important factor. Depth-sounders that measure distance to the ocean bottom also require exact timing.

Jewelers use watch rate recorders, expensive electronic machines that print in less than a minute the performance of a watch. One jeweler was not happy to learn from his customer, an NBS employee, that the watch rate recorder might possibly be in error. It was easily checked by recording WWV time ticks instead of watch ticks.

Many Meters to Watch

The station operates efficiently with a small staff: an engineer in charge and his assistant, an electronics technician, a general mechanic, and a grounds keeper. On the two nights a week no one is on duty at the station, one of the engineers, who lives in a house on the WWV grounds a few yards away, is on call. A bell rings in his house whenever the one in the station does. A large number of meters of various types require periodic inspection and recording of the readings.

A new milkman came in one day with a bottle for lunch. As he set it in the icebox he inquired politely, "You wouldn't by any chance have the time, would you?" The engineer in charge put down his sandwich and showed the milkman, among other things, what is probably the most accurate clock in the world.

There is never a planned shut-down at WWV. Lest there be a repetition of the seven-hour halt caused by the hurricane in 1954, two gasoline-operated generators have been installed. The engines can be started in thirty seconds, and after a two-minute warmup will supply enough electrical energy to operate two of the six transmitters at full power.

The Twin in the Pacific—WWVH

To give better service at Pacific Ocean points, the National Bureau of Standards established station WWVH on the island of Maui, Hawaii, in 1949. WWVH keeps in step with WWV, and broadcasts the same

(Continued on Page 142)

UNITRON student microscopes offer

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The UNITRON Student Auto-Illumination Microscope, Model MSA, employs a newly designed stand in which all components and controls are within easy reach. The inclined eyepiece tube allows comfortable posture and may be turned in any optional observing direction to permit two students sitting side by side to share a single instrument. With the built-in illuminating system of the superior low-voltage type, each student is assured of the correct lighting. The transformer is conveniently housed in the microscope base itself where it contributes to the stability of the stand rather than to the clutter of the laboratory table.

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The Weather

• By Henry Rockwood
UNITED STATES WEATHER BUREAU

Weather forecasting is an ancient art, but meteorology is a relatively new science. Airplane travel has created a demand for accurate weather forecasts, and the meteorologist in answering this demand makes use of the basic principles of many sciences.

The Pittsburgh section of the American Chemical Society sponsors a series of radio programs. This article is a digest of one of their 1953 programs. It is used here with their permission.

●

All of you have been conscious of weather going on around you for a great many years. Northerly winds bring the cold of winter and the welcome cool spells of summer; easterly winds frequently bring rainy weather; and, in the summer time, as you watch those white cloud masses gradually build up and thicken to become dark and threatening, you recognize that a thunderstorm may break out before long. Even as a youngster, you probably learned such age-old weather saying as:

"Red sky at night, sailor's delight;
Red sky at dawning, sailors take warning!"
or
"Mackrel skies and mare's tails
Make tall ships carry low sails."

Behind all this casual knowledge and understanding of weather events lies a science, the science of meteorology. As a science it has its own jargon, or language, in which appear such terms as High, Low, Front, Adiabatic, Isothermal, Anemoometer, and Radiosonde—to name just a few.

This science is young, perhaps, as compared to astronomy, physics, and chemistry. It does not lend itself easily to laboratory studies and to statement of laws and rules of cause and effect. It would be difficult, if not impossible, to produce a hurricane or a tornado in a laboratory and study it, as one might study the composition of table salt, or the effects of static electricity. Nevertheless, it is a science whose problems are as near to you as the use of a fan to bring comfort in the summer heat, and as far distant as the sun itself, the source of the energy involved in all our weather.

While all science, in fact all affairs of mankind, benefit from the interchange of information between one nation and another, meteorology by its very nature is international beyond all the restrictions of censorship or "iron curtains." The storms that we may experience in this country are likely to make their appearance some days later in Europe. The air that sits over the snow-covered Steppes of Siberia in the winter will eventually show up as a cold wave that might destroy the citrus crops of California or Florida. The strange appearance of the sky one Sunday in September, 1950, over Pittsburgh, when the sun and moon assumed new colors, was caused by smoke from forest fires in western Canada. The smoke rose into the upper levels of the air, became part of one of the rivers of air that flow across southern Canada, and dipped southward as a broad thick stream that cut off the sunlight as it passed above many cities such as Winnipeg, Cleveland, Pittsburgh and Washington; then, much as the Atlantic Gulf Stream does, this air stream turned northeastward across the Atlantic, and its effects were reported within another day or two from England and western Europe.

Just as the study of weather requires an understanding of world-wide weather events and their interrelationships, so does the science of meteorology require a knowledge of many other sciences. The chemist finds that mathematics, physics, engineering, biology, and other such fields all play their part in his broad study of the subject of chemistry. Likewise, the meteorologist soon learns that his science rests heavily upon the fields of mathematics and physics and includes many others such as geography, oceanography, hydraulics and hydrology, glacierology, and chemistry.

One of the most important fields of investigation in meteorology is the study of ozone in the atmosphere. Fluctuations of ozone concentrations at high levels (the ozone layer) are evidently directly connected with solar radiation. The movement of ozone from the high levels to lower levels is believed to be connected with atmospheric changes important to the meteorologist and may eventually serve as a new key to the forecasting of weather. According to the biologists the presence of ozone in the atmosphere, through its influence upon the amount of ultraviolet radiation reaching the earth, also plays an important part in the well being of animal life on the earth. Yet we really know very little about atmospheric ozone. It is in the boundary zone of several sciences and as one writer expresses it, we really need a highly trained analytical chemist who is also well qualified in the field of physical chemistry and physical meteorology just to properly sample and analyze air for its content of ozone.

It is not surprising therefore that graduate chemists as well as engineers, physicists and mathematicians frequently end up as meteorologists. We find, for example, that the fundamental laws and relationships of mechanics, physics, optics, hydraulics, aerodynamics, statistics and many others all must be used in one or more of the various fields of interest within the broad subject of meteorology.

Meteorology is often divided into three general classifications: dynamic meteorology, synoptic meteorology, and climatology; somewhere within those classes or blends of those classes, every meteorologist finds his field of employment. The dynamic meteorologist is

usually thought of as the student of the atmosphere, its broad circulation patterns, its gain and loss of heat and momentum, its definition by formulas or equations —in other words, the theoretician. The synoptic meteorologist is usually the weatherman that most of us think of—the one who makes the day-to-day weather forecasts—who thinks mostly in terms of what the weather is right now and what it will be within certain periods of time over certain definite areas. The synoptic meteorologist or forecaster has frequently been accused of using a "rule of thumb" to interpret weather conditions. Actually, he is the man on the firing line, trying to apply the dynamic meteorologists' statements and equations to the day-to-day problem of understanding, interpreting, and anticipating the weather, so that you and I will know whether to carry an umbrella or to bundle up warm against a cold wave or blizzard.

The climatologist, on the other hand, knows that the fundamental laws of the atmosphere tend to produce certain types of weather over broad regions of a country, giving to those regions a climate. Climate varies from place to place and can vary within a small area. For most purposes, however, it is sufficient to evaluate it in terms of wet or dry, warm or cold, and combinations or graduations of these. On the other hand, the climatologist may be called upon to explain why an orchard should be placed on a particular piece of land, rather than on another, to get the most sun and be in the least danger of frost.

It is easy to see that no hard and fast line separates these men into different compartments. The researcher may become the forecaster, or vice-versa; the forecaster may find himself dealing with climate and its variations within a state when he says where the rain or snow will fall the heaviest, while he looks to the dynamic meteorologist to explain why those particular climatic variations should develop. In western Pennsylvania, many speak of the "snow belt" stretching approximately from Butler to Meadville. This is a climatic fact; the forecaster must keep it in mind; and the theoretician has helped explain the reason for its occurrence. That thunderstorms are more frequent and heavier in the Allegheny Mountains than around Pittsburgh is a fact that the forecaster keeps in mind when advising you about the weather to expect while you are taking a trip into or across the ridges on a humid summer day.

The most interesting feature of meteorology to most of us, I am sure, is that we are dealing with nature, whose powers and energies make the atomic bombs look like toys. The everchanging aspect of the sky and the broad sweep of weather from west to east, bearing the cold arctic winds of winter or the hot humid tropical air of summer, holds an ever-constant challenge; to define, to interpret, to understand, and to anticipate the coming event whether it be the balmy breezes of spring, the powerful hurricane of the tropics, the terrifying tornado of our temperate zone, or the calm clear breath-taking cold of a winter night. Can you meet that challenge? ●

Educational TV Project

(Continued from Page 123)

Mathematics

Clifton Fadiman, the noted author, critic and radio and television personality, has been signed to host this series. He has appeared on a number of educational programs as well as on more popular type shows. He also has done extensive research in mathematics.

This series will be organized around the major "breakthroughs" or discoveries in mathematics. It will show how these breakthroughs have advanced everyday living as well as the science of mathematics.

The programs will go into such areas as the discovery of number; the contributions of Euclid and Descartes to mathematics; the development of the calculus and the first attempt to use the infinite. One program will show the importance of the development of the theory of mathematics and another will show how important is the role of mathematics in industrial 20th Century.

Experiments and demonstrations will be used to illustrate the theme.

Survival (Resources and Civilizations)

This series will feature Albert Burke, who was host on the spring NBC-ETRC series "Geography for Decision." Burke's services are being made available by the Conservation Foundation, which has employed him specifically to make it possible for him to give full time to the preparation and execution of the series.

Burke is a geographer and economist who has taught at Yale University. He is executive director of the American Institute of Resource Economics.

The series will explore the ways in which the natural resources available to people condition their ways of life and it will point out implications for the future of the rapidity with which the supply of such resources as coal, gas and iron are being reduced by the demands of modern industrial societies.

The first program, for example, will contrast the Australian aborigine with an American, showing how the resources of the aborigine are few as compared with the resource needs of the American.

For purposes of illustration, the productive process that makes the fountain pen possible in everyday living will be traced in order to underscore the complex nature of industrial civilization. On the other hand, a tool or weapon important in the aborigine's affairs will be treated similarly—to show the simple character of his stone age culture.

Throughout the series attempts will be made to show how various civilizations rely on certain resources and how the western world must develop new resources as traditional resources become exhausted.

Guest authorities from various fields will appear on this series as in the other four areas.

The Arts and the Gods (Greek Mythology)

This series will bring out the relationship of mythology to various art forms—sculpture, painting and music. Professional performers will help to illustrate the subject through dance and music.

Most of the programs will come from the Greek art gallery of the Metropolitan Museum of Art in New York City.

Alexander Scourby, television, stage and cinema actor, will serve as host for the series. He narrated many of NBC-TV's "Project 20" programs, including "Nightmare in Red," "The Twisted Cross" and "Three, Two, One—Zero." He has played on Broadway in "Detective Story," "Darkness at Noon," and "St. Joan." He has recorded more than 200 books for the blind—novels and non-fiction—for the Library of Congress.

Camera on Washington

Originating in Washington, D. C., the series will explore the machinery of the executive branch of government. Various aspects of the executive branch of government will be explored in depth by the TV cameras and through interviews with specialists in the operations under consideration. Remote location broadcasts will be made from such departments and agencies as the U. S. Information Agency, the National Health Institution, the Weather Bureau, the Department of the Treasury, and the Pentagon.

The series will have meaning for adults and young people alike, but will have special significance for high school social studies students.

Bill Henry, who has been one of NBC's top Washington correspondents, will serve as host for the series. His background includes more than a decade of Washington news analysis and commentary. He has been especially prominent in coverage of national elections. ●

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Hot Coals And Clinkers

(Continued from Page 117)

lathes, drill presses, shapers, saws and grinders, electric welding, oxy-acetylene welding and cutting, hydraulics, light and power and signal wiring, telephones, motor and control repairs, blue print reading, and how to solve basic electrical problems. A great deal of field work, especially visits to coal mines under instruction and careful supervision, went on as well. Incidentally, it must be remembered that in the USA young men are prohibited by law to work in our coal mines till they have reached the age of eighteen. There are however no restrictions upon young men below eighteen to work in coal mining offices on routine office matters. This offers opportunity for high school lads, in their summer months, to make some money for various personal needs.

For years, and until the trade association of the bituminous coal management instituted an educational

service so that teachers, textbook authors, and publishers, could receive up-to-date information on the methods of coal mining, increasing safety provisions, the home life of the miners, their compensation, and most of all the drama in this basic industry, the amount of mis-information about that industry to be found in our school books and encyclopedias, was nothing less than appalling. Since 1945-6, with the development of such a free educational service to both teachers and students, and not the least to geography and other social studies writers, the story of our coal industry has begun to be told accurately. The "clinkers" in our former textbooks have been removed, year by year, and the up-to-date account of what coal mining is really like, how basic it is to our civilization, and what its contribution is and will continue to be in our daily lives, is now the order of the day.

Educational thinking has been changed so that we see, in "hot coals", the beneficent sources of light, heat, power, and energy without which our American civilization as it is today would be impossible. Bituminous produces our tools, our sky-scrapers, our bridges, our buildings, our farm-machinery, because, through coke, it helps to make steel. It governs our mobility. The railroads, the freight cars, the locomotives, the trucks, the steamers, the pipe-lines, are dependent on steel, and again bituminous coal makes coke to make steel. It enters into our enjoyments. Thousands of chemical derivatives come from bituminous coal: beginning with synthetic perfumes and shaving lotions, to textiles, dyes, raincoats, paints, costume jewelry, and synthetic fibres like nylon. Bituminous coal is indispensable in time of war. All high explosives, which include TNT, picric acid, and tetryl, come from bituminous in whole or in part. In World War II, bituminous derivatives contributed to the making of block busters, marine and land mines, anti-tank cannon, torpedoes, mortars, bombs, no less than to the manufacture of battleships, cruisers, destroyers, and plane carriers. It is indispensable in time of peace. It makes possible the tens of thousands of useful commodities that are derived from the basic chemicals out of bituminous coal carbonization: e.g., ammonium sulfate, sulphur, benzol, toluol, naptha, xylol, phenols, and naphthalene. It nourishes our farms, and adds hundreds of medicines and antiseptics and pain-relievers, no less than sulpha drugs, to our pharmacy stores.

Enrollment today in some activity of this four-billion dollar basic industry, means a career for a lifetime in an industry of dynamic vitality. ●

★ ★ ★ ★ ★

To train a citizen is to train a critic. The whole point of education is that it should give a man abstract and eternal standards, by which he can judge material and fugitive conditions.—*G. K. Chesterton.*

Plentiful Rare Earths

(Continued from Page 110)

TABLE 2

Typical composition of the rare earth mixture extracted from monazite ore (expressed as rare earth oxide)

Rare earth oxide	%	
Lanthanum oxide, La_2O_3	24	
Cerium oxide, CeO_2	48	
Praseodymium oxide, Pr_6O_{11}	5	
Neodymium oxide, Nd_2O_3	17	
Samarium oxide, Sm_2O_3	3	
Gadolinium oxide, Gd_2O_3	2	(approx.)
Yttrium oxide, Y_2O_3	0.2	(approx.)
Other rare earth oxides	0.8	(approx.)
	100	

Rare earths and thorium are extracted from monazite ore on a commercial scale by either treating the ore with sulfuric acid or with sodium hydroxide solutions. In the sulfuric acid process, the monazite is cooked with concentrated sulfuric acid to convert the thorium and rare earth phosphates to anhydrous thorium and rare earth sulfates. These are dissolved in water and thorium is separated from the rare earths by precipitation as thorium pyrophosphate or by making use of the fact that some thorium compounds such as thorium phosphate and basic thorium salts are less soluble in dilute acid solutions than are the corresponding rare earth salts.

Most of the applications for rare earths involve using the rare earths in the mixture in which they are found in the ore. However, there are many important applications which require the use of individual rare earths or highly purified rare earths.

Cerium is separated from the rare earths by oxidizing it to the tetravalent state. The solubilities of many ceric (Ce^{+4}) compounds are much less than those of the corresponding trivalent rare earth compounds, and separation is effected by precipitating salts such as basic ceric nitrate, ceric hydroxide, or crystallizing salts such as ammonium hexanitrato cerate.

Lanthanum and neodymium are separated from the cerium-free mixture (this mixture is often called "didymium") by fractional crystallization processes using water soluble salts such as the double ammonium nitrates $La(NO_3)_3.2NH_4NO_3.4H_2O$. The lighter rare earth salts are the least soluble of these rare earth salts, and recrystallization of this double salt gives lanthanum preparations, and finally neodymium materials.

Formerly, all of the rare earths were separated by fractional crystallization of such salts as the double nitrates, sulfates, bromates, ferrocyanides, ethylsulfates, etc. Many thousands of recrystallizations had to be made, and in most cases, the separated rare earths so obtained were never pure.

The rare earths samarium, europium, and ytterbium can be separated from rare earth mixtures by reducing them to divalent Sm^{+2}, Eu^{+2}, and Yb^{+2}. Europium is reduced to Eu^{+2} with zinc, and samarium and ytterbium are reduced to the divalent forms with, for example, sodium amalgam. The divalent ions form amalgams from aqueous solutions quite easily, and can thus be separated from the other rare earths which do not show this property.

At present, nearly all of the rare earths are separated by ion exchange methods which give exceptionally high purities. The rare earth mixture is absorbed on a column of cation exchange resin, and is then eluted through a long resin column with a coordinating agent such as ammonium ethylenediaminetetraacetate. Differences in the coordination ability of the rare earths result in separation and formation of rare earth-resin bands in the resin column, and when sufficiently separated, the purified rare earths are eluted off the columns.

The rare earth industry in this country processes about 10,000 tons of monazite ore annually. Most of the uses for rare earths do not require extensive rare earth separation, but some require extremely high purities. Consequently, the industry produces materials ranging from unseparated rare earth mixtures to individual separated rare earth salts having purities as high as 99.99%.

Most rare earth products do not reach the average person in the form in which they are supplied by the industry—rather they serve as starting materials for, or become component parts of, many everyday things.

About one-quarter of the rare earth chemicals is used in carbon arc lighting applications. Rare earth-cored carbons are indispensable to the motion picture industry both in studio lighting and in theater projection. Army, Navy and Coast Guard searchlights also use these rare earth-cored carbons.

Another quarter of this country's rare earth and thorium production is used to make rare earth metal (Misch metal) and cerium metal. These metals are used in producing lighter flints, and have shown promise in creating better alloy steels and magnesium alloys for high temperature service. There are some applications in which rare earth and thorium salts are used directly in producing alloys, and some types of steel.

A third quarter of the rare earth production is taken by the glass industry. Rare earth salts, didymium (cerium-free) salts, neodymium salts and cerium salts all have important uses in the coloring and decolorizing of glass. Cerium hydrate is used as an ingredient in the glass face plates of color television tubes. Cerium oxide and rare earth oxides are widely used in the polishing of spectacle and optical instrument lenses, as well as mirrors and other glass specialties.

There are other miscellaneous rare earth applications. These include the use of lanthanum oxide and thorium oxide in a silica-free glass, the coloring of table glassware and novelty glass items with neodymium salts, the use of an oxalate as a nausea preventive, and the use of didymium salts in temperature-compensating condensers for radio, television, and radar applications.

TABLE 3

SOME USES FOR RARE EARTHS

Carbon-Arc Lighting	Ceramic Opacifiers
Motion Picture Projection	Ceramic Coloring
Lighter Flints	Catalysts

Alloy Steels
Medium and Low-Carbon Steels
Stainless Steels
Rare Earth-Zirconium-Magnesium Alloys
Glass Coloring
Glass Decolorizing
Ingredient in Color TV Tubes
Polishing of:
Lenses, mirrors, television picture tubes and implosion plates, quartz crystals, granite, marble and semi-precious stones
Textile Waterproofing
Scavenger in Explosive Manufacture
Activators for Fluorescent Lighting
Photosensitive Glass
Glass Windows for Radiation Protection
Capacitors for Electronic Equipment
Aluminum Alloys
Paint Driers
Sunglasses
Glass Blowers' Goggles
Welders' Goggles
Neutron Absorbers in Nuclear Reactors
Nausea Preventive
Reagent Chemicals

★ ★ ★ ★ ★

The Aerosols

(Continued from Page 113)

is produced when the product is used. It may be defined in the following way:

$$\% \text{ overrun} = \frac{\text{volume of foam} - \text{volume of liquid} \times 100}{\text{volume of liquid}}$$

The amount of overrun depends primarily on the concentration of the propellants and the nature of the aqueous formulation. In one case, the overrun was 117 per cent using 10 per cent of a propellant with a shampoo. When the concentration of the propellant was increased to 20 per cent, the overrun was doubled, but the product was rather stiff and dry.

What is the aerosol market? This is a much used but poorly defined term. Actually, there is no specific aerosol market. Aerosol is only one of many means of packaging or dispensing an item. We can think of such products as soaps, shaving creams, etc. in many different types of packages or dispensing forms. The penetration in a product market by an aerosol formulation varies from a substantial share in the case of the insecticides, hair lacquers, and shaving creams to a relatively small share of their respective fields by some of the newer aerosol products. If past experience can be accepted as indicative of a continuing trend, the future for these new products looks extremely bright. As the method becomes more widespread, the horizons seem limited only by the extent of creative imagination. Today the progressive manufacturer who first markets a new aerosol product or who puts into aerosol packaging an old established item stands an excellent chance of absorbing a very substantial share of the overall market for that product.

All aerosol items which are sold to the retail consumer must come under the Federal and State laws, such as the Food, Drug and Cosmetic laws. Under such laws each item and formulation is subjected to scrutiny as to the safety and toxicity. We can therefore use these items in our daily living with complete confidence. Under such packaging we have items literally at our finger tips which previously entailed a great deal of time in preparation and in many cases, special manipulative skills and techniques. ●

Driver Education

(Continued from Page 122)

The New Horizons and Challenges

What are the new horizons and challenges in driver education? Here again are my ideas:

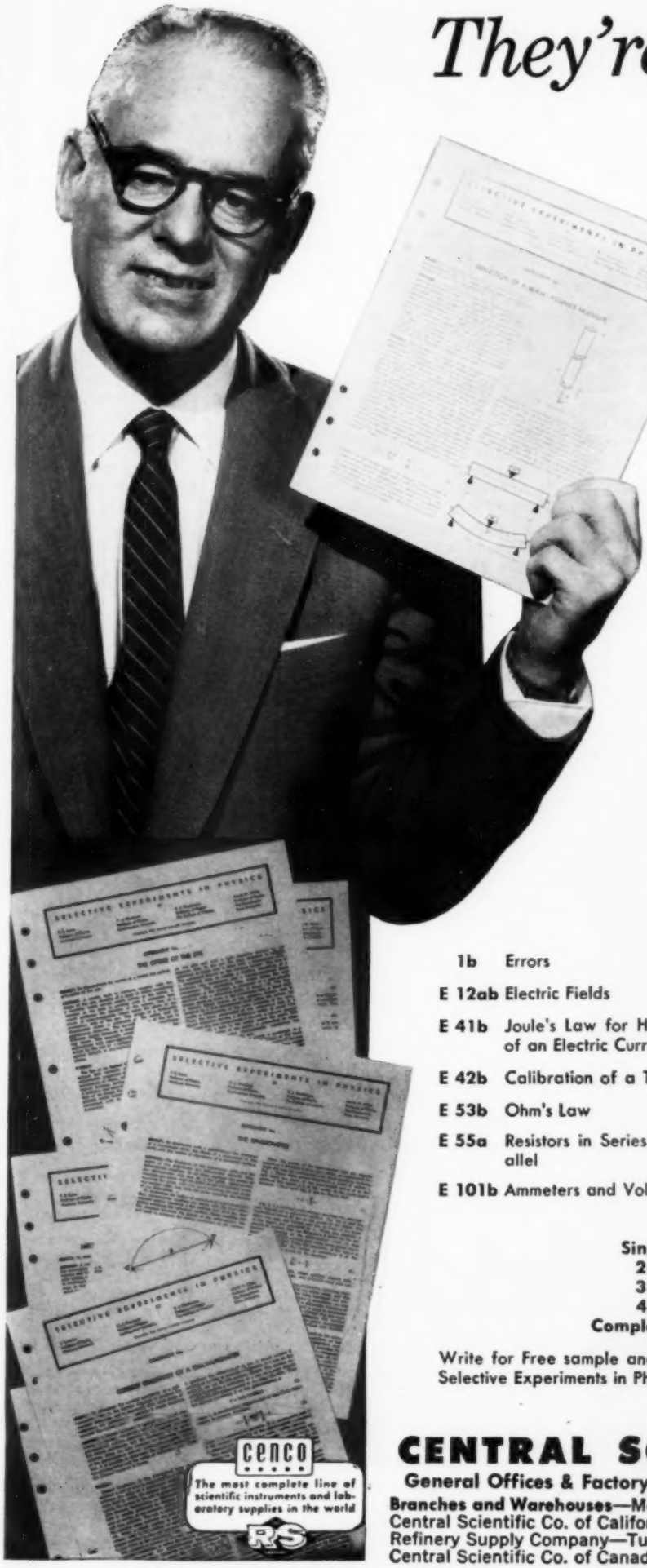
1. Are you including instruction in your driver education course on how to drive safely and efficiently on freeways, parkways, and toll roads? Driving on such roadways requires special training. Are your drivers receiving such training?
2. Are you reaching all of the eligible students in your school? Are you still teaching the same number you did two years, five years or ten years ago? Are you making any real progress with your program?
3. Do your students get the minimum recommended standard driver education course, or are you doing a better job than just meeting minimum standards?
4. Are you using available research data in your driver education course? Never forget, future progress in this field, as well as other fields, depends very much on the results of research studies.
5. What have you done in the last five years to help improve your teaching? Have you completed at least 12 semester hours of credit in safety education? Have you gone beyond the teacher certification requirements in your state?
6. Have you made any attempt to get acceptance of your driver education course by the top-flight educators in your community? Are you willing to accept their statement that driver education is just another added frill to our school program?
7. Have you worked out an approach to use to get public support in your community for your driver education course? When did you last appear to tell the story at one of your service clubs, parent-teacher meetings, high school assembly, on radio, on television, other media?
8. Are you offering your course just to prepare boys and girls to get a driver's license? Or, are you preparing safe, courteous and efficient vehicle operators?
9. Do you have a high percentage of boys enrolled in your driver education course, or do they consider your program a "sissy" activity? What are you doing to improve this situation?
10. Are you conducting driver education courses for adults during your spare time? If so, are you wearing yourself down to the point where you are inefficient in conducting your high school program?
11. Do you really practice what you preach? Or are you a hypocrite like so many others—educator in name only?
12. The real challenge today is to get teachers to do the master's job—a little more and a little better than is usually expected from a teacher. Are you willing to be a mediocre teacher?

In Conclusion

If we believe that our greatest potential in obtaining safe, smooth, orderly and efficient movement of traffic is through driver education in every high school, and in reaching every boy and girl as they are legally old enough to drive, then it is our job as educators to seek this goal, being mindful at all times of maintaining high standards. Cicero gave us guidance when he said:

"What Greater or Better Gift can we Offer the Republic than to Teach and Instruct Our Youth." ●

★ ★ ★ ★ ★



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New Books

Professional Amateur

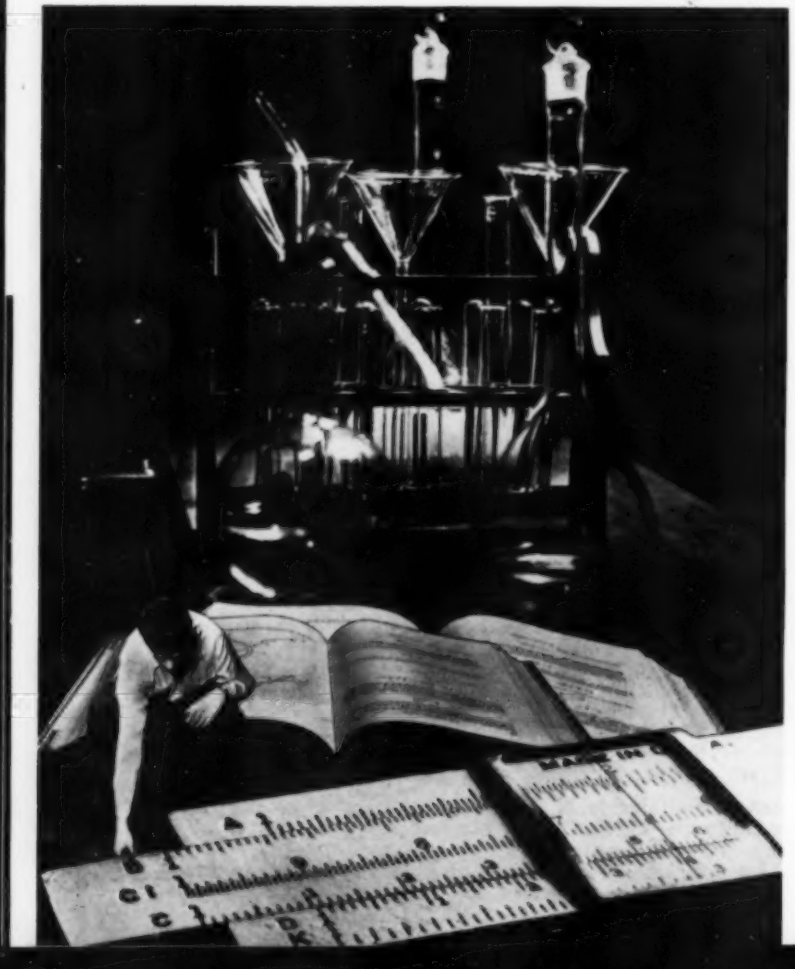
• *By* T. A. Boyd. E. P. Dutton and Company, Inc. New York. 1957. Pp. xii + 242. $4.50.

Charles Franklin Kettering, industrialist, inventor and humanitarian, is the subject of this biography. The author, a long-time friend and associate of "Boss Kett," has succeeded in presenting a pleasing picture of the life and work of his friend, and has avoided the laudatory excesses so common in the biographies of living persons. The book can also be recommended for its portrayal of the development of our American industries during the early half of the twentieth century.

Kettering started his life's work as a teacher in a one room school. As a novice teacher, he manifested the ability for bold creative thinking and hard work that was characteristic of all his later activities. Teachers who read his life will feel that, in spite of his successes as an inventor and industrialist, he remained a teacher at heart.

The title is taken from one of Kettering's statements: "We are all *simply professional amateurs.* We are amateurs because we are doing things for the first time. We are professional because we are going to have a lot of trouble. The price of progress is trouble." While we may disagree with the above definitions of professional and amateur, we must agree that, as defined, they accurately describe Charles Franklin Kettering.

Photo by Vic Kelley



The Space Encyclopaedia

• General Editor: M. T. Bizony. New York. E. P. Dutton and Company, Inc. 1957. Pp. 287. $6.95.

The success of the Russian satellite has created a demand for a reference book to supply the answers to the questions which such an event provokes. *The Space Encyclopaedia* provides the answers in a popular and easily readable style.

Authentic and up-to-date information on rockets, satellites, upper atmosphere research, outer space, and astronomy is provided in a manner that will satisfy both the non-scientist and scientist. Lengthy articles on the artificial earth satellite, astronomy, cosmology, and rocketry alone make the book a worthwhile investment. Many fine illustrations and diagrams excellently fulfill their purpose of clarifying the text. The authors of the articles are authorities in their fields, and some are engaged in active research in the subjects they discuss.

This book should be in every school and college library, and we most highly recommend it to every citizen who is intelligently interested in the recent developments in modern science or international relations.

Facts And Fallacies In The Name Of Science

• *By* Martin Gardiner. Dover Publication, Inc. New York. 1957. *Paper bound.* Pp. 363. $1.50.

This is a factual and sensible treatment of the subject of pseudo-science. It will both entertain and irritate the serious reader, who will find the extremes of the self-styled scientist amusing, but he will cease to be amused when he reflects on the harm their theories have caused.

The most shocking revelation in this book is the number of persons who enjoy a reputation for scholarship, reputable magazines and newspapers that have been active in the spreading of scientific fallacies. Cancer cures, flying saucers, Bridey Murphy, spiritism and food fads have all found supporters among those who should know better. In view of this support of unorthodox science, Martin Gardiner has performed a real service to science.

Every student and teacher should read this book.

J. P. M.

Botany, An Introduction To Plant Science

• *By* Robbins, Weier and Stocking. Second Edition. John Wiley and Sons, Inc. New York. 1957. Pp. 578. $6.95.

This is a text for elementary courses in college botany. It is written in such a way that it can be used in either a one or a two semester course. The authors have used simple language to convey concepts before applying the scientific terms, thus aiding the student in acquiring an understanding of the basic phenomena as well as an accurate scientific vocabulary.

The organization of the book is the logical sequence of: the nature and scope of botany in general; the structure and functions of parts of a familiar flowering plant; the functioning whole plant in relation to its immediate environment; the survey of the plant kingdom, using carefully selected examples to illustrate the

(Continued on Page 138)

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Micro-Corneal Lenses

(Continued from Page 118)

with but a few hours of sleep and wore their lenses consistently during the 20 waking hours. The balance of about 25% of micro-lens wearers come into the category of those who can get between 4 to 8 hours per day. People's personality and sensitivity vary. Once we get used to them, the eyes are conditioned to the lenses and wearing time is increased. Under average conditions, the limit will be accomplished approximately 6 - 8 weeks after the person begins to wear the lenses. It is recommended, if my technique is used, that at the outset the person begin to wear his or her lenses one hour per day, and gradually increase daily use by a schedule outlined to the patient, and varying it according to existing circumstances.

Micro-lenses are recommended for the following persons:

1. Those who have corneal scars, keratoconus, or other eye conditions, where regular spectacles do not afford adequate vision, but the micro-lens improves it materially.

2. Persons who psychologically are unhappy wearing spectacles and believe their appearance will be improved and their mental attitude will be a happier one.

3. Post operatively after cataract extraction (aphakia) and other binocular imbalance or eye muscle defects, especially where one or both eyes require strong lenses, more frequently in nearsightedness.

4. Persons connected with the stage or other public appearances, dancers, etc., where glasses are prohibitive and micro-lenses become a professional necessity and adjunct to their equipment.

5. For sports with occasional exceptions.

6. Any person who needs good eyesight but cannot or will not wear spectacles of the conventional type.

Micro-corneal lenses have replaced the scleral contact lenses in all instances, except in the case of football players, divers and certain types of swimmers. In the case of a football player, because of the roughness of the game, the fluidless scleral lens has still its place. We have fitted many football players with micro-lenses, somewhat larger than ordinary, but where the person is satisfied with 2 - 3 hour wearing time, the scleral type for this sport is still the better. For swimmers we use both types, depending on one's habits. Where a person dives into water, or swims under water with his eyes open, the scleral type has less tendency of being washed out of the eyes by the tide or water motion. If the person swims under water with his eyes closed or slightly squinted, the micro-lenses are quite satisfactory. With micro-lenses, the swimmer should keep his head above the water level, if he swims with his eyes open.

There is one more type of a person for whom scleral lenses are to be used. He is a person who may have had an eye damaged to the extent that his cornea is completely scared, vision there is none, and the appearance is disfiguring. Here we use a scleral contact lens over the disfigured eye. This lens has baked in an artificial "iris," prepared of harmless vegetable dye to match the color of the good eye. It will also have a central black area to simulate the pupil and on the scleral (white) section, the appearance of blood vessels make the contact lens replace the eye's projection, an artistic piece of work. This is purely for cosmetic purpose. Enucleation of the eye (removal by surgery) is not necessary, but instead, this type of scleral contact lens gives one a normal appearance, even much more so than an artificial eye would, should the eye have been removed. This lens can be worn by the patient all day, as it merely covers the eye which has no vision.

We have progressed far with the use of micro-lenses and with the fluidless scleral lens in special instances, this progress completes a dream come true. Yet, we still feel that those who wear micro-lenses, should by all means have handy a pair of regular spectacles for emergency, such as when a lens is dropped on the floor and is stepped on, or is lost altogether. Even persons who wear them consistently and use them all day, should still regard them as another pair of glasses. The extra spectacles are like an insurance policy. We have it, even though we hope we never will have the occasion to use it. Micro-lenses enabled many a person to live a much happier life, we are fortunate to live in an age when they are so successfully available for public use. ●

★ ★ ★ ★ ★

New Books

(Continued from Page 136)

form and life histories of the great group of plants; and finally, evolution within the plant kingdom. The system of classification which is used is the most modern widely accepted system.

The illustrations are numerous and excellent. Summaries in each chapter aid the student in selecting the most essential material from the wealth of information presented in the text. The glossary is extensive and gives the origins of the technical terms defined.

Helena A. Miller, Ph.D.
Biology Department
Duquesne University

★ ★ ★ ★ ★

. . . There is a deep psychological truth in the sneer of Goethe's Mephistopheles that man used reason to be more bestial than the beast. Does not Coleridge insinuate a similar idea by saying that it is principally by the will that we are raised over the estate of an animal? Both men read history and knew something of psychology. They were not theorizing. Knowledge itself saves nobody from delinquency.

—RICHARD H. TIERNEY, S.J.
In The *Catholic Mind*, 1915

Electric Stop Signs For Fish

Reinforced plastic stop signs are being used to warn people and halt lampreys in the Great Lakes fishing area by the U. S. Fish and Wildlife Service. For several years lampreys, an eel-like fish, have been killing edible fish and threatening the livelihood of many persons in the Great Lakes region.

To combat the lamprey threat, electrically charged lines have been stretched across the area where the lampreys return from spawning. The electric charge acts as a barrier to repel the lampreys from entering feeder streams in which they spawn, or having spawned, are prevented from returning to the lake.

Polyester resin signs are strategically placed to warn passersby of the electrically-charged water. The signs are posted on land and in the water. Lampreys who can read the sign avoid the fish version of the "hot-foot."

God In The Science Classroom

For those of us who believe in God and are engrossed in public school science education there sometimes arises the problem of whether or not to speak of God in our classrooms. Some situations or explanations seem to call for it, but then the old bug-a-boo of separation of church and state—or some such idea—raises its ugly head and we squelch our impulse. When we subdue it what word do we put in place of "God"? Why the word "nature", of course.

We do not believe that the doctrine of a particular sect should be taught in the public school classroom, but an idea can be killed by ignoring it long enough. Public school education is doing this to the idea of God.

We in science education have a golden opportunity to stop ignoring the idea of God by the simple expedient of saying God when we mean God. Also to express to our students the fact that there is no wall between science and religion, and that the building wouldn't collapse if a science teacher expressed a belief in God.

Webster lists two definitions of nature which would be applicable to a scientist's use of the word "nature".

From Webster's Collegiate—

1. The system of all phenomena in space and time; the physical universe; as the study of nature.
2. An agent, force, or principle, or set of such forces or principles, viewed as creating, controlling, or guiding the universe; as by provision of nature.

The first, of course, does not refer to God but to his creation. The second, however, speaks of creation and infers some Godly attributes and therefore is merely another word for creator or God. In Science teaching we often use the word in both senses. Why could we not with clear conscience substitute "God" wherever we use the second meaning. This would actually be more scientific reporting or speaking more truthfully. The true scientific mind chafes at beating-around-the-bush.

Murray Gell-Mann and E. P. Rosenbaum use nature in the second sense in their article entitled *Elementary Particles*, pg. 88 of the July 1957 SCIENTIFIC AMERICAN. Let me quote: "Why has nature chosen to use this particular set of particles to build the material world". They could just as easily have said, "Why has God cho----------".

On the other hand the title of the magazine NATURE is an example of the use in the first sense. Here we could not ask for a change for it would become nonsensical.

The idea of God and mention of Him fit into the science classroom in many other places. This crossed my mind recently as I introduced a high school chemistry group to the Conservation of mass and energy. Is it not appropriate to say that "the Lord has given us a certain amount of matter—or energy—and that we must use and exist on just this amount, neither creating nor destroying it". The connection is a natural, and I believe the idea is philosophically and scientifically sound.

Other instances crowd the mind. We have another "natural" connection in discussions of the origin of the universe.

I feel that this is an idea we Christian teachers should consider.

David D. Porter
Washington High School
Portland, Oregon

★ ★ ★ ★ ★

The activity of the western mind, which manifested itself alike in scientific and technical invention as well as in geographical discovery, was not the natural inheritance of a particular biological type; it was the result of a long process of education which gradually changed the orientation of human thought and enlarged the possibilities of social action. In this process the vital factor was not the aggressive power of conquerors and capitalists, but the widening of the capacity of human intelligence and the development of new types of creative genius and ability.

—C. DAWSON.

Time Signals Are Used

(Continued from Page 125)

services on 5, 10 and 15 megacycles. Its radio predictions are for the North Pacific radio paths, such as Seattle to Tokyo or Anchorage to San Francisco. The forecasts are prepared by the NBS North Pacific Radio Warning Service at Anchorage. The pattern of the broadcasts is very similar for the two stations, except that the periods of silence are different, and no voice announcements are made.

Headquarters at Boulder

The radio stations and related activities are directed from the NBS Laboratories at Boulder, Colorado. The Boulder Laboratories, which maintain the USA primary frequency and time interval standards, monitor the frequency and time broadcasts. The time signals are kept in agreement with "uniform time" as determined by the U. S. Naval Observatory, Washington, D. C. When necessary an adjustment of 20 milliseconds (20 thousandths of a second) in the broadcast signals of both stations, WWV and WWVH, is made on Wednesdays at 1900 Universal Time (2 p.m. Eastern Standard Time).

The Visitors' Book

Stations in many countries broadcast their own standard time and frequency signals. Officials and scientists from the following countries, among others, have visited WWV: Australia, Canada, China (Taiwan), Colombia, Ethiopia, Brazil, France, Britain, India, Italy, Japan, Pakistan, Russia, Switzerland and Thailand.

Besides official and technical correspondence regarding WWV and WWVH, many letters from listeners and users of the broadcasts all over the world are received at the NBS Boulder Laboratories.

Some Day the Atom

Under the same experimental conditions, atoms and molecules have the same vibration rates everywhere on the earth. This fact is being used, both at NBS and elsewhere, to develop atomic standards of frequency and time based on the unchanging properties of the atom. An atomic standard would be more constant and dependable than the present standard, the rotating earth, which varies from time to time and is also gradually slowing down.

NBS scientists predict that some day the quartz crystal oscillators at WWV and WWVH will be tied to an atomic frequency standard. When this is done the stations may need little or no outside information in order to broadcast the correct frequency. And the accuracy of the broadcasts may be even greater than is now possible.

★ ★ ★ ★ ★

O God! all things' sustaining power,
Remaining in Thyself unchanged,
Who hast the flight of every hour,
By daylight's altered gleam arranged.

—Hymn from None.

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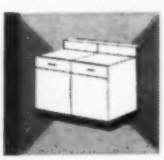
INSTRUMENT MANUFACTURING SHOPS

CHEMICAL MANUFACTURING DIVISION

DEVELOPMENT LABORATORIES

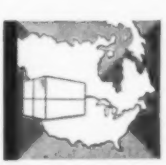
UNITIZED LABORATORY FURNITURE



CUSTOM GLASS BLOWING

SERVICE and REPAIR SHOPS

STOCKS IN 7 MAJOR CITIES



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1957

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You Can Depend on the GENATRON

● THE MODERN ELECTROSTATIC GENERATOR

THE CAMBOSCO GENATRON serves not only for classical experiments in static electricity, but also for new and dramatic demonstrations that are not performable by any other means. It exemplifies a modern method of building up the tremendously high voltages required for atomic fission, for nuclear research, and for radiation therapy.

Entirely self-exciting, the GENATRON cracks into action at the snap of the switch —whose only function is that of starting the motor drive. No auxiliary charging method is employed. Hence, despite an output measured in hundreds of thousands of volts, no hazard is involved, for the operator or for the observers.

An Output of 250,000 Volts — or More!

THE CAMBOSCO GENATRON is designed to deliver, in normal operation, a discharge of the order of 250,000 volts. That figure, a conservative rating, is based on many trials conducted under average conditions. With ideal conditions, a potential difference of 400,000 volts has been achieved.

Modern Design — Sturdy construction and ever-dependable performance distinguish the GENATRON from all electrostatic devices hitherto available for demonstration work in Physics. This powerful, high-potential source, reflecting the benefits of extensive experience in electrostatic engineering, has absolutely nothing but purpose in common with the old fashioned static machine.

NO FRAGILE PARTS — Durability was a prime consideration in the design of the GENATRON which, with the exception of insulating members, is constructed entirely of metal.

The only part subject to deterioration is the charge-carrying belt, which is readily replaceable.

NO TRANSFER BODIES — In all conventional influence machines, whether of Holtz or Wimshurst type, electrical charges are collected and conveyed (from rotating plates to electrodes) by a system of "transfer bodies." Such bodies have always taken the form of metal brushes, rods, button disks or segments—each of which, inevitably, permits leakage of the very charge it is intended to carry, and thereby sharply limits the maximum output voltage.

It is a distinguishing difference of the GENATRON that electrical charges, conveyed by a non-metallic material, are established **directly upon the discharge terminal.** The attainable voltage accordingly depends only upon the geometry of that terminal and the dielectric strength of the medium by which it is surrounded.

Unique Features of the CamboscO Genatron

DISCHARGE TERMINAL Charges accumulate on, and discharge takes place from, the outer service of a polished metal "sphere"—or, more accurately, an oblate spheroid.

The upper hemisphere is flattened at the pole to afford a horizontal support for such static accessories as must be insulated from ground. A built-in jack, at the center of that horizontal area, accepts a standard banana plug. Connections may thus be made to accessories located at a distance from the GENATRON.

CHARGE-CARRYING BELT To the terminal, charges are conveyed by an end'ess band of pure, live latex — a CamboscO development which has none of the shortcomings inherent in a belt with an overlap joint.

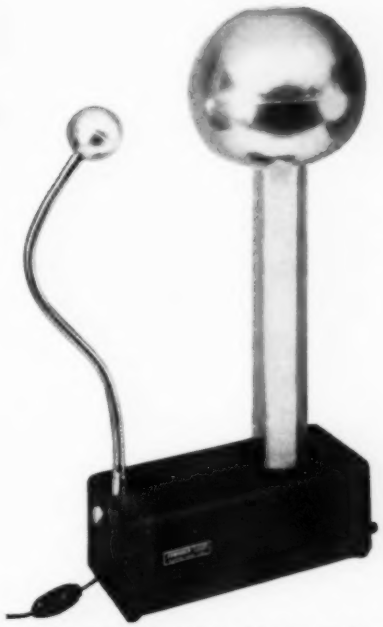
DISCHARGE BALL High voltage demonstrations often require a "spark gap" whose width can be varied without immobilizing either of the operator's hands.

That problem is ingeniously solved in the GENATRON, by mounting the discharge ball on a flexible shaft, which maintains any shape into which it is bent. Thus the discharge ball may be positioned at any desired distance (over a sixteen-inch range) from the discharge terminal.

BASE...AND DRIVING MECHANISM Stability is assured by the massive, cast metal base—where deep sockets are provided for the flexible shaft which carries the discharge ball, and for the lucite cylinder which supports, and insulates, the discharge terminal.

The flat, top surface of the base, (electrically speaking), represents the ground plane. Actual connection to ground is made through a conveniently located Jack-in-Head Binding Post. The base of the Genatron encloses, and electrically shields, the entire driving mechanism.

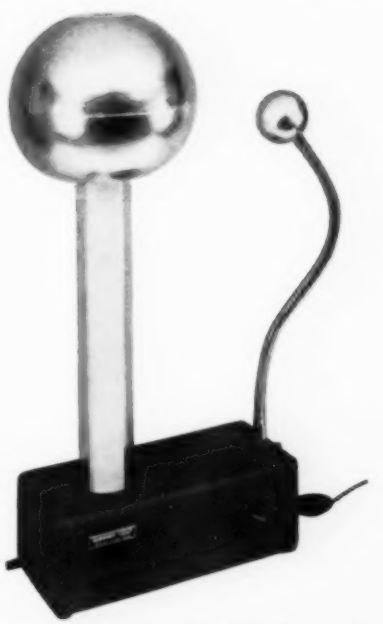
PRINCIPAL DIMENSIONS The overall height of the GENATRON is 31 in. Diameters of Discharge Ball and Terminal are, respectively, 3 in. and 10 in. The base measures 5¼ x 7 x 14 in.



GENATRON, With Motor Drive

Operates on 110-volt A.C. or 110-volt D.C. Includes: Discharge Terminal, Lucite Insulating Cylinder, Latex Charge-Carrying Belt, Discharge Ball with Flexible Shaft, Accessory and Ground Jacks, Cast Metal Base with built-in Motor Drive, Connecting Cord, Plug, Switch, and Operating Instructions.

No. 61-705 - - - - $98.75



GENATRON, With Speed Control

Includes (in addition to equipment itemized above under No. 61-705) a built-in Rheostat, to facilitate demonstrations requiring less than the maximum output.

No. 61-708 - - - - $109.00

No. 61-710 Endless Belt. Of pure latex. For replacement in No. 61-705 or No. 61-708. **$3.00**

CAMBOSCO SCIENTIFIC COMPANY

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